5.3.2 Distribution, Abundance and Temporal Variability

Long term averages of zooplankton standing stock in the Southern California Bight show that peak abundance in the upper 140 m of the water column occurs in the spring and summer months, with lowest abundance in the winter (Mullin, 1986; Smith. 1971). Abundance data over much of the Bight indicate that during February to July, 64-256 cc/1,000 m^3 of zooplankton are present, and in October and January large patches of lower densities (16-64cc/ 1000 m^3) occur. In 1975, abundances of zooplankton and icthyoplankton underwent large seasonal fluctuations (Figure 5.3). In the Southern California Bight, peak zooplankton abundance occurred inshore during March and May and offshore in May, and ichthyoplankton abundance had reached a peak during January and March. The inshore area experienced a second peak in November. In both inshore and offshore areas, northern anchovy dominated the ichthyoplankton throughout the year. Seaward of the permit area (CalCOFI-Region IX), hake larvae were dominant.

Loeb et al. (1983) found significant differences north and south of Point Conception in zooplankton and ichthyoplankton abundance and composition (Figures 5.4 and 5.5). Zooplankton volumes were nearly twice as high in the coastal area north of Point Conception compared to the Southern California Bight. Larval fish abundance, however, was over twice as high in the area south of Point Conception in the Southern California Bight, attesting to the great importance of this area as a spawning and nursery ground for fish. Table 5.3B presents the relative abundance of the top 10 larval fishes collected at different spatial locations within southern California (Cross and Allen, 1993). The northern anchovy (*Engraulis mordax*) represented the most abundant fish larvae collected within the California Current, Southern California Bight, and coastal (< 100 km) environments.

In nearshore waters, larvae of benthic invertebrates and fish are more abundant than observed offshore. These larvae include intertidal species such as barnacle cypris larvae and nauplii, mussel veliger larvae, and zoeal larvae of most crab species. The most abundant fish larvae nearshore are Gobiidae (gobies) and Engraulididae (anchovies) (Table 5.3B). Other commercially important species found in larval stages in nearshore waters include *Cancer magister* (Dungeness crab) and *Pandalus jordani* (pink shrimp) which are most abundant within 15 miles of shore (Lough, 1975; Rothlisberg, 1975).

The circulation of the Southern California Eddy provides a mechanism for maintaining populations of plankton within the Bight (Dawson and Pieper, 1993; Mullin, 1986; Owen, 1980). Benthic dwelling species with planktonic life stages must rely upon deposition in areas shallow enough to permit survival at the end of their planktonic stage. Examples include populations of the spiny lobster, *Panulirus interruptus* and the red crab, *Pleuroncodes planipes* (Longurst, 1968). CALCOFI surveys covering the spawning time and area of the northern anchovy *Engraulis mordax* have shown that the region inclusive of the Southern California Eddy comprised about 12% of the spawning area of the central subpopulation but contained 48% of the spawned larvae during the period 1951 to 1975 (Smith, 1978). Kleppel et al., (1982) and Brinton (1976) have shown that the eddy serves as a productive refuge for an identifiable population of the euphausid (*Euphausia pacifica*), one of the dominant species among the larger zooplankton of the Southern California Bight.

Table 5.3B. Relative Abundance of Top 10 Larval Fishes Collected in Southern California.

Taxa	Percent	Taxa	Percent
California Current		**SCB**	
Northern anchovy	49	Northern anchovy	80
Pacific hake	9	*Sebastes* spp.	6
Vinciguerria luceta	8	California smoothtongue	4
Sebastes spp.	6	Pacific hake	3
California smoothtongue	4	Mexican lampfish	2
Mexican lampfish	3	Sciaenidae	2
Northern lampfish	3	Popeye blacksmelt	<1
Citharichthys spp.	2	Shortbelly rockfish	<1
Pacific sardine	2	Boccacio	<1
Jack mackerel	2	Speckled sanddab	<1
SCB < 100 km of Coast		**Upper Newport Bay**	
Northern anchovy	83	Arrow goby	27
Sebastes spp.	4	*Anchoa* spp.	19
California smoothtongue	4	Gobiidae	12
Northern lampfish	2	Northern anchovy	10
White croaker	2	Cheekspot goby	9
Pacific hake	2	Shadow goby	8
Citharichthys spp.	<1	Sciaenidae	4
Popeye blacksmelt	<1	Longjaw mudsucker	4
California halibut	<1	White croaker	3
Hypsoblennius spp.	<1	Barred pipefish	2

From Cross and Allen (1993).

Data Sources:
California Current: Smith and Moser (1988)
SCB within 100 km of Coast: Gruber et al. (1982)
SCB: Loeb et al. (1983a,b)
Upper Newport Bay: Horn and Allen (1985)

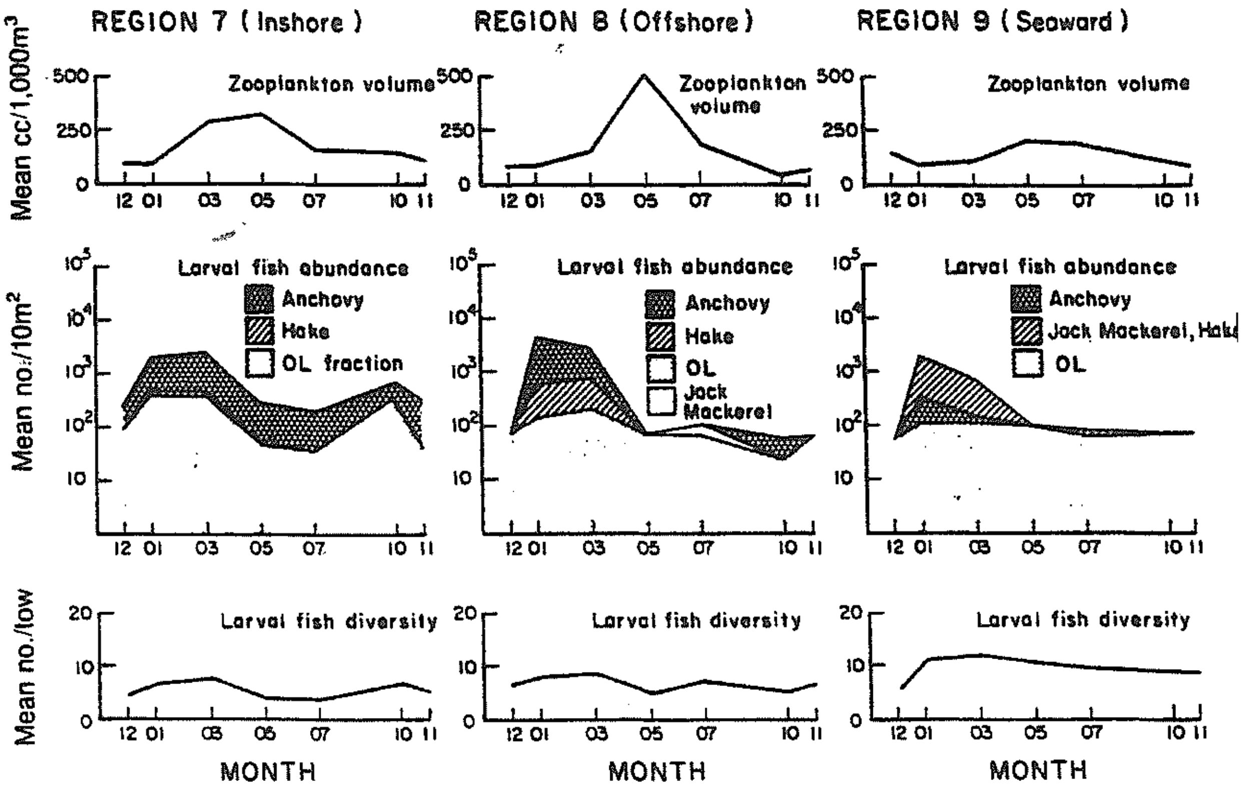


Figure 5.3

SEASONAL VARIATION IN ZOOPLANKTON VOLUME, ABUNDANCE OF FISH LARVAE, AND DIVERSITY OF FISH LARVAE IN CALCOFI SOUTHERN CALIFORNIA REGIONS 7, 8, AND 9 DURING 1975. "OL" REFERS TO LARVAL FISH OTHER THAN ANCHOVY, HAKE, SARDINE AND MACKEREL (From Loeb et al., 1983).

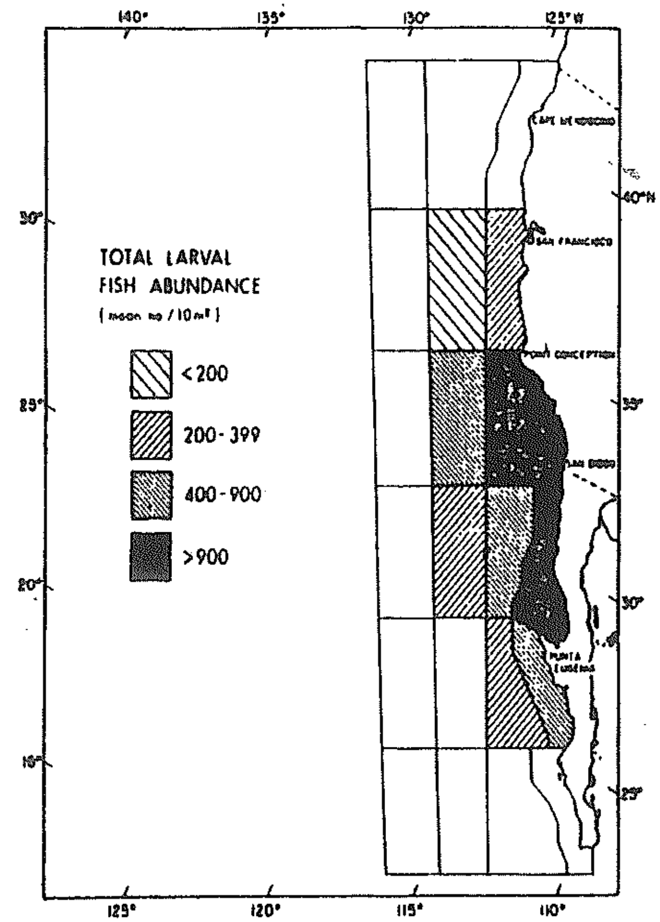


Figure 5.4

MEAN ZOOPLANKTON VOLUME IN 11 CALCOFI REGIONS SAMPLED DURING 1975 (From Loeb et al., 1983).

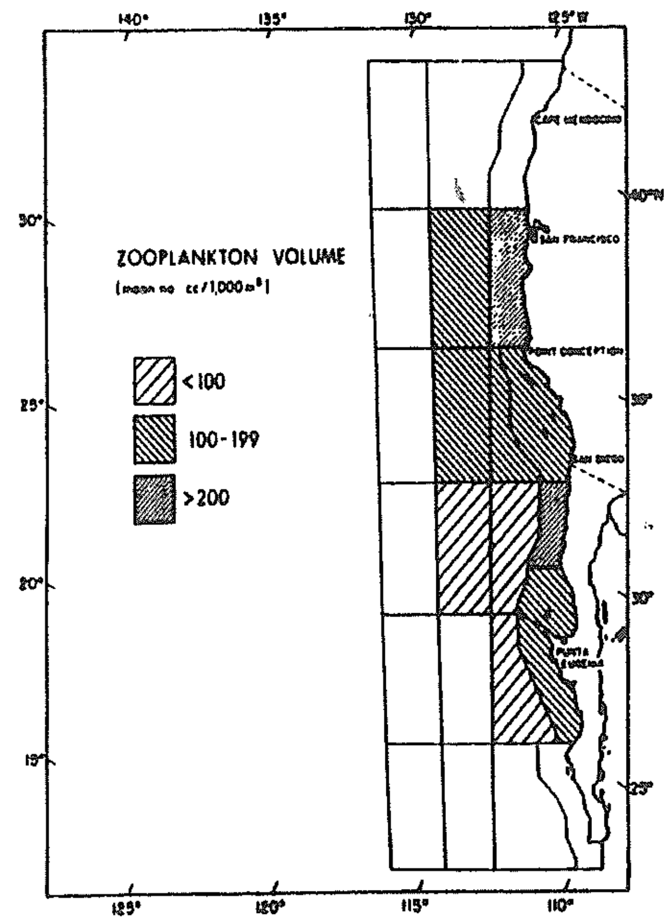


Figure 5.5

MEAN LARVAL FISH ABUNDANCE (TOTAL) IN 11 CALCOFI REGIONS SAMPLED IN 1975 (From Loeb et al., 1983).

5.4 Importance of Plankton

Phytoplankton and zooplankton are key components of all marine ecosystems. In the Southern California Bight, plankton form a major portion of the food base for pelagic and benthic communities. Phytoplankton are responsible for nearly all photosynthesis in marine waters, and are a primary food resource for zooplankton which in turn are fed upon by many other species. In upwelling regions such as the west coast of the United States, plankton productivity is high, supporting some of the richest fisheries in the world.

In the Southern California Bight, the links in the food chain are often very short with many commercially or ecologically important species directly dependent upon plankton as a food resource. The northern anchovy, *Engraulis mordax*, which supports one of the largest fisheries in the Southern California Bight and is a major food resource for other fish, bird and marine mammal species, feeds directly on both phytoplankton and zooplankton. Smith and Eppley (1982) have shown a direct correlation between plankton production and anchovy biomass in the Southern California Bight. Anchovy consumption of plankton was shown to be about 18% of primary production.

Humpback, blue, and minke whales in the Southern California Bight feed directly on zooplankton, primarily euphausids such as *Euphausia pacifica* (krill). Many bird species, including shearwaters, phalarope,s and murrelets rely on planktonic crustaceans and larval fish for a portion of their food supply. Plankton also forms a primary source of nutrition for most larval and juvenile pelagic fish species.

In addition to being consumers of phytoplankton, many larval fish and crustaceans also compose a significant portion of the zooplankton community.

5.5 BENTHOS

The benthic fauna of the permit area is highly diverse as a result of the bathymetric and hydrographic complexities of the region (Dailey et al., 1993). The bathymetry of the Bight is a mosaic of mainland and insular shelves, slopes, ridges, banks, basins, and canyons. As a consequence of this bathymetric complexity, there is a great diversity of substrate types ranging from hard substrate to a variety of unconsolidated sediments, each supporting a unique benthic assemblage. The hydrographic complexity results from the interaction of the cool southward-flowing California current and the warmer northward-flowing Southern California countercurrent (Hickey, 1993). Transport of pelagic larvae to the Bight by both current systems results in a diverse benthic fauna with species characteristic of areas to the north and south (Bakus, 1989).

Despite this complexity, the benthic fauna in the permit region has been intensively sampled (Figure 5.6) and is comparatively well known (Thompson et al., 1993; Bakus, 1989). This knowledge is based on over 4,000 sampling stations surveyed by numerous academic institutions, agencies, and private companies over at least a 50-year period. Among the principal studies referenced in this section are those conducted by the Allan Hancock Foundation, University

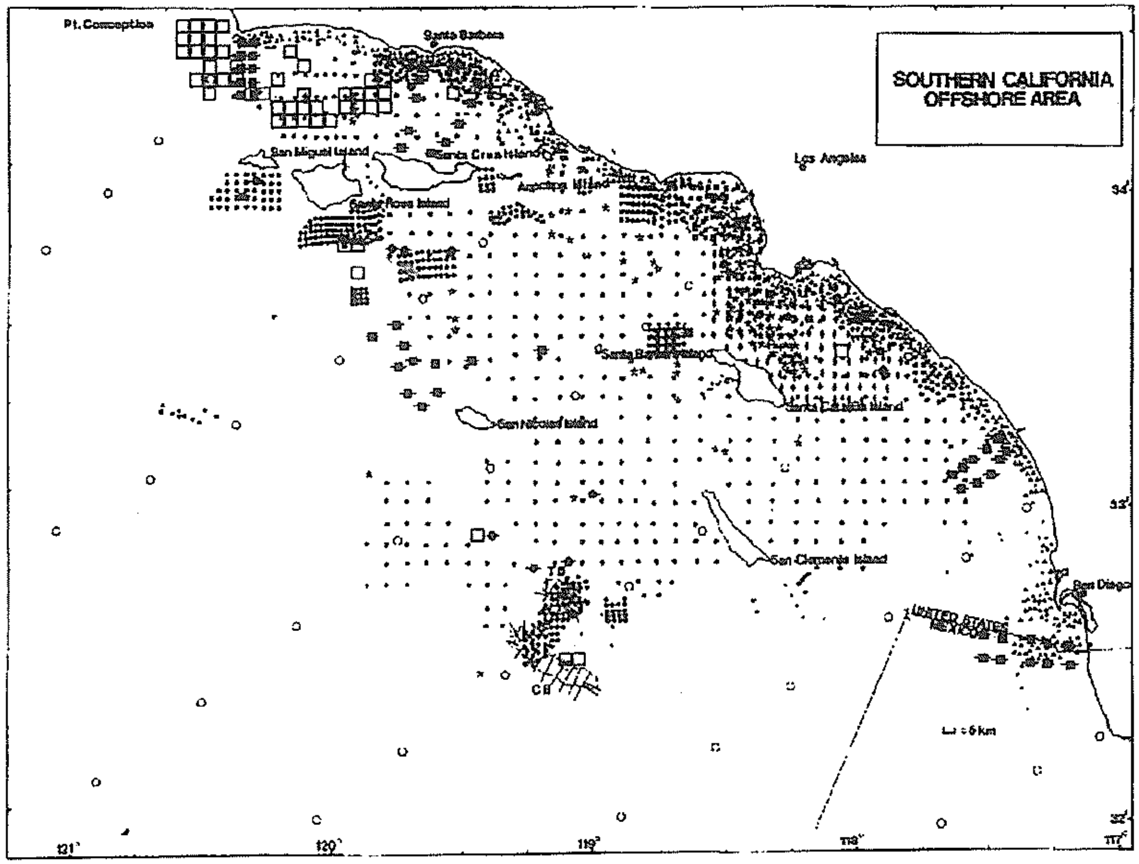


Figure 5.6. Major marine biological studies conducted in southern California, emphasizing benthic stations. CalCOFI stations are pelagic. Lease blocks indicate where oil and gas drilling may occur. -■- = BLM Descriptive Study (Fauchald and Jones 1979a); -◆- = BLM Benchmark Study (Fauchild and Jones 1979b); ★ = Deep Basins (Hartman and Bernard 1958); • = SCCWRP - 70 shelf stations (SCCWRP 1978); ▪ = Santa Barbara Basin (Fauchild 1971) and Santa Monica Basin (Hartman 1956); • = USC Department of Geological Sciences BLM and NSF - Microlab (Foram) Stations and BLM Baseline Studies (Fauchild and Jones 1983); ⋆ = Submarine Canyons (Hartman 1963); ▲ = California (Allan Hancock Foundation, University of Southern California 1965); ◈= San Pedro Basin (Hartman 1955); O = CalCOFI Pelagic Stations (Hewitt 1980); — = Interstate Electronics Corporation (1979) Submersible Study (43 transects) and Lewbel et al. (1981); □ = Lease Blocks OCS Lease Sale 48 (Leased by federal Government for exploratory drilling). Source: Bakus (1989).

of Southern California; Department of the Interior, Bureau of Land Management (BLM) and Minerals Management Service (MMS); Southern California Coastal Water Research Project (SCCWRP); and public sanitation districts as part of permit discharge monitoring requirements performed for the U.S. Environmental Protection Agency and Regional Water Quality Control Boards.

The first major, quantitative surveys of the benthic fauna off southern California were conducted by Hartman (1955, 1966), representing more than 200 samples from the shelf and slope in the San Pedro area. A similar investigation was undertaken in Santa Monica Bay between 1952 and 1956 from shallow depths out to 900 meters (Hartman, 1956). The first broad-scale macrobenthic investigation was performed under the auspices of the California State Water Resources Control Board between 1955 and 1960. Several thousand samples were taken in an area extending from Point Conception to the Mexican border and out to a depth of about 100 meters. The results of this study are presented in Barnard et al. (1959), AHF:USC (1965), and Jones (1969).

In the mid-1970s, the Minerals Management Service (then Bureau of Land Management) sponsored a comprehensive investigation of the Southern California Bight to obtain baseline data prior to proposed oil and gas development. As part of this program, Fauchald and Jones (1978, 1979a, 1979b) undertook a benthic survey of nearly all major benthic habitats off southern California. Sampling depths ranged from 7 to 1,886m and included the shelf, slope, basins, ridges and banks. The most significant contribution of this study was the characterization of the slope benthic communities, a faunal assemblage that previously had been poorly sampled.

Other significant benthic studies in the Southern California Bight include the basin studies of Hartman and Barnard (1958-1960), the submarine canyon studies of Hartman (1963), the Santa Barbara Channel investigation of Fauchald (1971), the Tanner and Cortes Banks submersible survey (IEC, 1979; Lissner and Dorsey, 1986), the benthic survey of the Santa Ynez Unit (Dames & Moore, 1982), and the SCCWRP 60-m control survey (Word and Mearns, 1979). More recently, SCCWRP documented results from a broad-scale survey of the benthic infauna of the Southern California Bight from the Mexican border to Pt. Conception covering inshore areas to the 200-m isobath (Bergen et al., 1999).

In contrast to the heavily sampled area south of Point Conception, fewer studies have examined the offshore benthic fauna north of Point Conception in the Santa Maria Basin region. Early submersible surveys in hard bottom areas were conducted by (Nekton (1981) and Dames and Moore (1982b), and infaunal surveys were performed as part of oil and gas related studies by Dames and Moore (1983), Engineering-Science (1984), Nekton (1983, 1984), and McClelland Engineers (1985). Infaunal samples in very shallow (less than 30m) depths were analyzed by IRC (1974) and Chambers Consultants and Planners (1982). More intensive studies have been conducted over the past 10 years by MMS as part of broad-scale reconnaissance and monitoring surveys to determine long-term effects on benthic communities from oil and gas development in the Santa Maria Basin. These studies included SAIC (1986), Lissner et al. (1991), Hyland et al. (1991, 1994), and SAIC and MEC (1995).

5.5.1 Faunal Distribution Patterns

The benthic fauna of the study area demonstrates high spatial variability (Figure 5.7a), much of which is correlated with depth or depth-related factors, such as substrate, temperature, and current patterns (Thompson et al., 1993; Bakus, 1989). Both macrofaunal density and species richness (number of species) demonstrate sharp decreases with increasing depth (Figure 5.8), with values for these parameters in basins (greater than 1,000 m) commonly one-third the values for shelf areas (less than 200m). Biomass also shows a tendency to decrease with increasing depth. Both low and high standing crops have been reported for shallow areas but only low standing crops are found in deep areas (Thompson et al., 1993).

The influence of depth-related factors is also reflected in the relative dominance of the various major taxa. In shallow depths, polychaetes typically comprise the greatest proportion of the standing crop (25-50%). Further offshore the relative contribution of the polychaetes to total biomass tends to decrease, with echinoderms contributing proportionately more to the total macrofaunal biomass (Thompson et al., 1993; Barnard et al., 1959). On the lower slopes and in some basins minor phyla may become dominant in terms of total biomass (Thompson et al., 1993; Fauchald and Jones, 1979a). Over the Southern California Bight as a whole, echinoderms make up the greatest proportion of the biomass (45%) followed by polychaetes (21%), minor phyla (16%), molluscs (11%) and crustaceans (6%) (Thompson et al., 1993; Fauchald and Jones, 1978). Although polychaetes are second to echinoderms in terms of relative biomass, they are generally dominant in terms of density and particularly in the number of species (Thompson et al., 1993; Bakus, 1989; Word and Mearns, 1979; Fauchald and Jones, 1978).

The degree of temporal variability in the macrobenthos in the permit region off southern California is relatively low in comparison to other oceanic waters surrounding North America. Seasonal variability is most pronounced in the intertidal and very shallow subtidal regions, but is relatively minor below depths of about 30 m (Thompson et al., 1993; Thompson, 1982). Fauchald and Jones (1979a) suggested that while some macrobenthic recruitment may continue throughout the year, most recruitment is observed from January through June. They reported an increase in density and areal species richness from winter to summer in shallow waters, but no similar increase was consistently observed in deeper waters. Recruitment was observed in some species at all depths, including basins.

The benthic fauna of the permit region is discussed below in terms of four major habitats: mainland and insular shelves, slopes, basins, and banks.

5.5.1.1 Shelf Fauna

The most recent broad scale summaries of shelf invertebrates in the permit region include SLC (2000), Thompson et al.(1993), and Bakus (1989). The depth of the shelf break off southern California is highly variable and dependent on regional geomorphology, however, for this discussion the shelf is assumed to extend to a depth of 150-200 m. There are two shelf habitats within the study area: the mainland shelf and insular or island shelves. Although there are some differences in the species composition of these areas, such as a greater proportion of crustaceans on

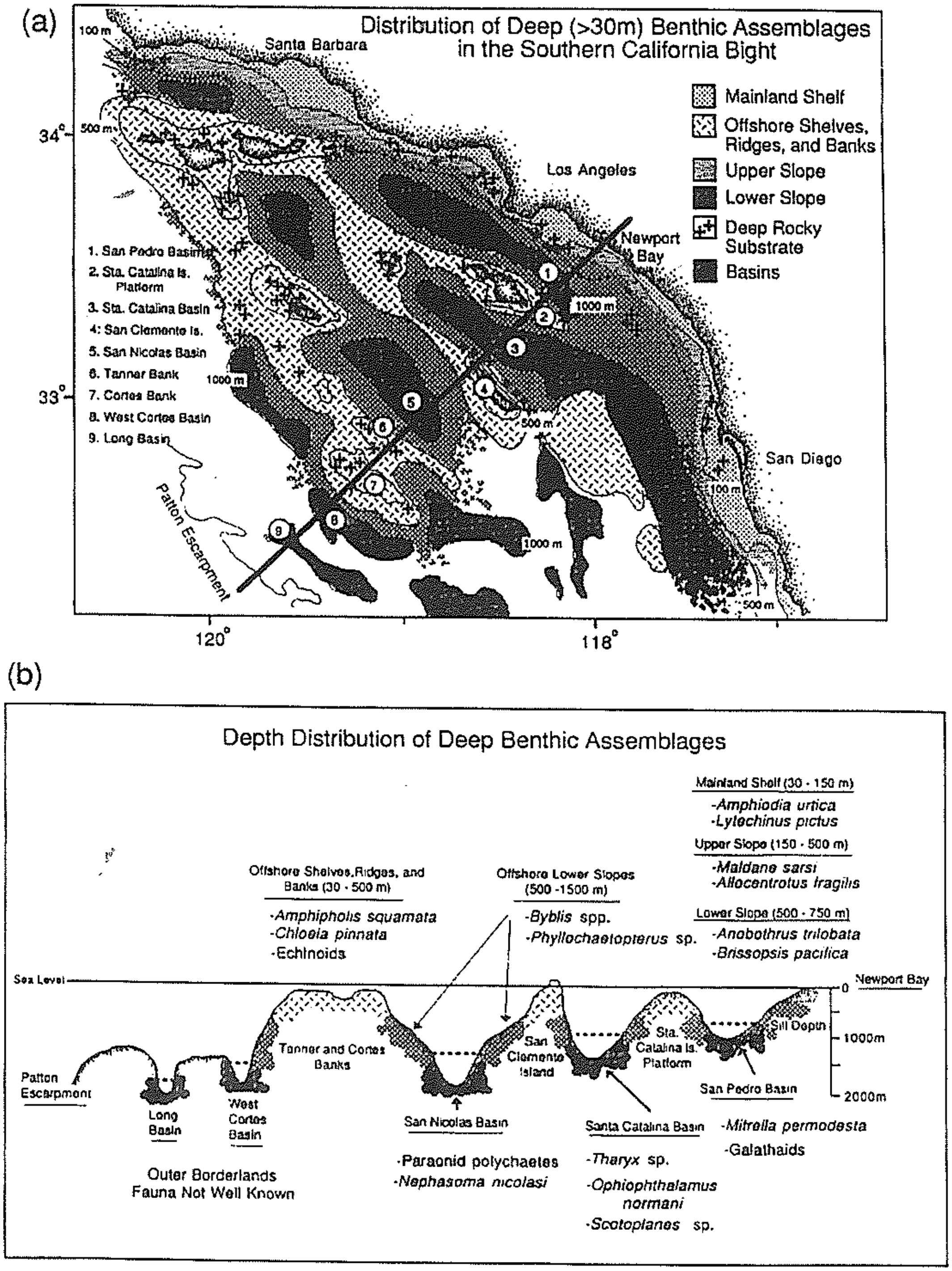
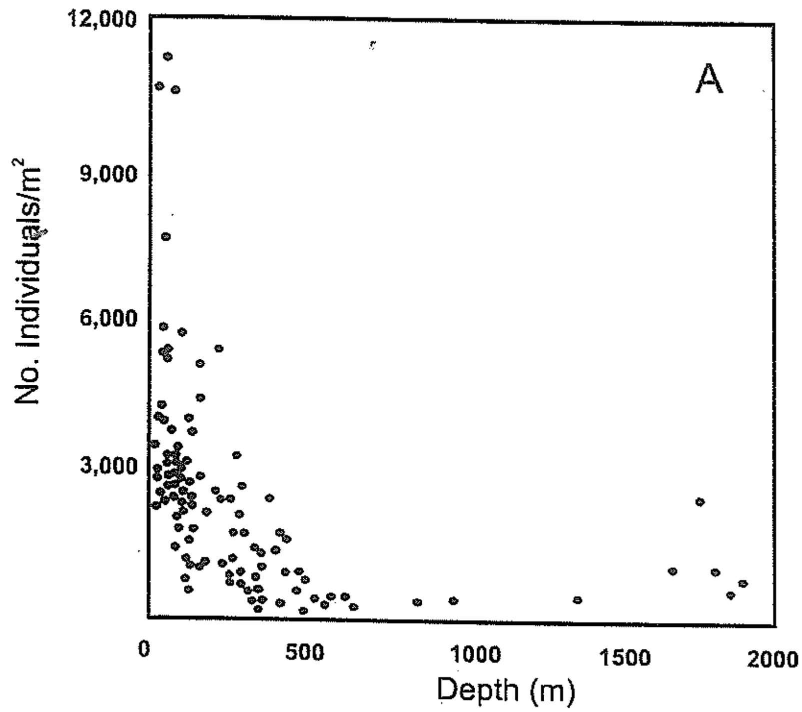


Figure 5.7. (a) Chart of southern California borderland showing the distribution of the major deep benthic assemblages (deeper than 30 m). Heavy transect line is shown on cross section in part (b). (b) Cross-section of the southern California borderland showing depth distribution of major benthic assemblages and characteristic fauna.

Source: Thompson et al. (1993).



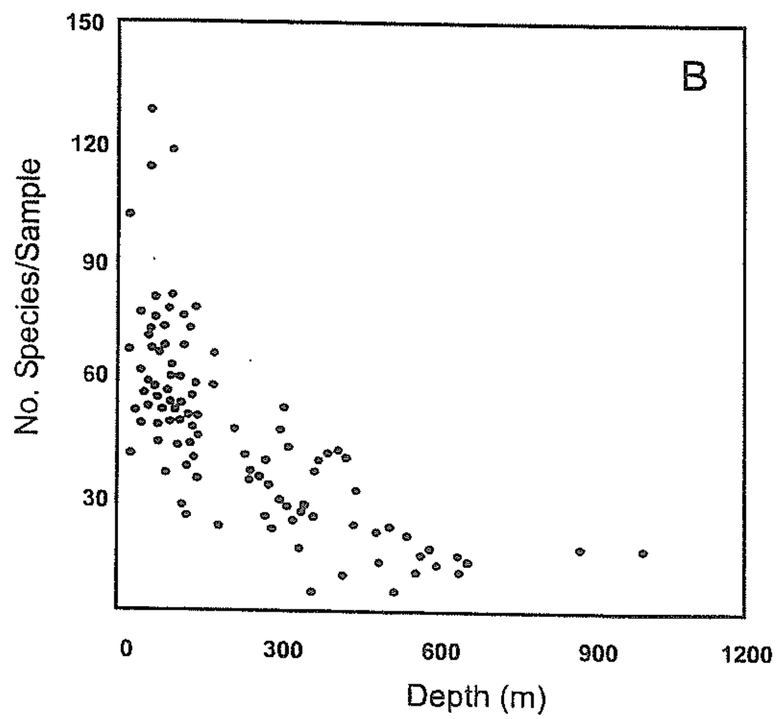


Figure 5.8. Macrofaunal Density (A) and Areal Species Richness (B) with Depth in the Southern California Bight. Source: Fauchald and Jones (1978).

the island shelves, the differences are relatively minor and the two areas are similar in most regards.

Faunal assemblages on the shelf generally conform to the bathymetry, forming distinct zones in a banded pattern parallel to the shoreline (e.g., Figure 5.7b). Such a pattern has been reported in the vicinities of Point Conception, Coal Oil Point, Point Dume, Huntington and Laguna Beaches, San Diego and San Miguel Island (Thompson et al., 1993; Bakus, 1989; Fauchald and Jones, 1978, 1979b). In most of these cases, shallow, intermediate and deep assemblages were recognizable. A summary of general infaunal and epifaunal species types in various habitat types (soft bottom versus hard bottom) and depth ranges is presented in Table 5.4 (SLC, 2000).

Bergen et al. (1999) summarized the infaunal communities in the Bight as consisting of a shallow assemblage typified by a *Nothria-Tellina* community, while an *Amphiodia* community is widespread in mid- and deep-water habitats. Sub-communities in the *Amphiodia* community were characteristic of coarse and fine grain sediments, although with few exceptions they have very similar dominants (e.g., Tables 5.5 and 5.6).

These results are very similar to the communities observed during the State Water Control Board investigations of the 1950s (AHF:USC, 1965). In shallow, coarse sediment areas, several assemblages were present including those typified by the polychaetes *Diopatra ornata* and *Nothria elegans -Tellina buttoni* (mollusc). The most widespread assemblage of the southern California mainland shelf was the brittlestar *Amphiodia urtica* community which occurred in depths of 35-90m and covers 23% of the total shelf area (AHF:USC, 1965). North of Ventura, the mollusc *Cardita ventricosa* was common and co-dominated with *A. urtica.*

Studies conducted for MMS that examined infauna communities between Pt. Conception and Pt. San Luis also identified depth as the major factor influencing community structure (Hyland et al., 1991). Higher densities and number of species were found than at similar depth ranges off the southern California coast. The 90-m depth stations were dominated by the polychaetes *Mediomastus* and *Chloeia*. *Amphiodia uritica* also was characteristic of the community at this general depth, suggesting a similarity to the *Amphiodia* assemblage described for the Southern California Bight. Stations sampled at 145-160m also were typified by these species. Hyland et al. (1991) noted that most of the polychaetes, crustaceans, and molluscs found in their study area have geographic distributions with a northern affinity. The study area is located at the boundary of the Oregonian and Californian zoogeographic provinces, to the north and south, respectively.

Epifaunal invertebrates in the permit region are generally found in moderate to high numbers, typified by seastars, brittlestars, gastropods, and cnidarians such as seapens and anemones (Table 5.4), and variable (low to high) density and biomass (e.g., SLC 2000).

Table 5.4. Typical Invertebrate Groups and Common Species Types Found within the Specified Habitats and Depth Ranges.

	Habitat Types		
Depth Range (m)	**Soft Bottom (mostly fine-grained)**	**Low Relief (<1 m) Hard Bottom**	**High Relief (>1 m) Hard Bottom**
30-200 shelf	Polychaetes *Mediomastus* *Nothria* *Spiophanes* *Paraprionospio* *Cossura* *Nephtys* *Maldane* *Pectenaria* Brittlestars *Amphipholis* *Amphiodia* Seastars *Astropecten* *Luidia* Sea urchins *Lytechinus* Sea Pens *Stylatula* Molluscs *Octopus* *Cyclocardia* *Tellina* *Parvilucina* Crustaceans *Photis* *Euphilomedes* *Sicyonia*	Cnidarians *Metridium* *Paracyathus* *Caryophyllia* *Lophogoria* Seastars *Asterina (Patiria)* *Mediaster* *Henricia* *Rathbunaster* Brittlestars *Ophionereis* *Ophiacantha* Sea cucumbers *Parastichopus* *Crustacea* *Galatheidae* *Loxorhynchus* Misc. Phyla "turf" (low growing) species including various sponges, cnidarians, bryozoans, and tunicates	Cnidarians *Metridium* *Corynactis* *Actinostola* *Paracyathus* *Caryophyllia* *Desmophyllum* *Lophogoria* *Allopora* *Amphianthus* Seastars *Asterina* *Mediaster* *Henricia* *Rathbunaster* Brittlestars *Ophiacantha* *Amphipholis* Crustacea *Galatheidae* *Loxorhynchus* Sponges Various erect species, typically uncommon Misc. Phyla "turf" (low growing) speciesincluding various sponges, cnidarians, bryozoans, and tunicates

Table 5.4. Continued.

Depth Range (m)	Soft Bottom (mostly fine-grained)	Low Relief (< 1 m) Hard Bottom	High Relief (> 1 m) Hard Bottom
200-600 m upper and middle slope	Polychaetes *Paraprionospio* *Maldane* *Lumbrineris* *Tharyx* *Chloeia* *Pectinaria* Sea stars *Astropecten* *Luidia* Sea urchins *Allocentrotus* *Brissopsis* *Brisaster* Sea Pens *Stylatula* Crustaceans *Euphilomedes* *Amphipods* Molluscs *Mitrella* *Pleurobranchaea*	*(150-300 m)* Cnidarians *Metridium* *Balanophyllia* *Caryophyllia* Seastars *Mediaster* *Hippasteria* Brittlestars/Basketstars *Ophiacantha* *Ophionereis* *Gorgonocephalus* Crinoids *Florometra* Crustacea *Galatheidae* *Loxorhynchus* Misc. Phyla "turf" (low growing) species including various sponges, cnidarians, bryozoans, and tunicates (>300 m) Similar species as noted for 150-300 m	*(150-300 m)* Cnidarians *Metridium* *Stomphia* *Actinostola* *Desmophyllum* *Lophelia* *Amphianthus* Seastars *Mediaster* *Peridontaster* Brittlestars/ Basketstars *Gorgonocephalus* *Ophiacantha* *Ophionereis* Crustacea *Galatheidae* *Loxorhynchus* Sponges Various erect species (e.g., shelf, sponge, and vase) Misc. Phyla "turf" (low growing) species including various sponges, cnidarians, bryozoans, and tunicates (>300 m) Similar species as noted for 150-300 m, but with increased abundances of erect sponges and in some areas cnidarians

Table 5.5. Comparison of Common Species in the *Nothria-Tellina* Assemblage and SCCWRP Shallow Depth Group. (from Bergen et al., 1999) * Denotes dominant in the *Nothria-Tellina* assemblage.

Old Species Name	Current Name	Percent Occurrence: Nothria-Tellina Assemblage	Percent Occurrence: SCCWRP Shallow Group
Chaetozone spp.	*Chaetozone corona, C. setosa*	98.2*	71.2
Amphiodia urtica	*Amphiodia urtica*	98.2	45.4
Prionospio pinnata	*Paraprionospio pinnata*	96.4*	86.4
Lumbrineris spp.	*Lumbrineris spp.*	96.4	71.2
Haploscoloplos elongatus	*Leitoscoloplos elongatus*	92.7*	34.8
Prionospio malmgreni	*Prionospio Sp. A* and *B (SCAMIT), Apoprionospio pygmaea*	90.9*	80.3
Tellina buttoni	*Tellina modesta*	89.1	75.8
Ampelisca cristata	*Ampelisca cristata*	80.0	69.7
Goniada spp.	*Goniada brunnea, G. maculata*	80.0*	27.3
Paraphoxus epistomus	*Rhepoxynius* menziesi	74.6	62.1
Nuculana taphria	*Nuculana taphria*	74.6	36.4
Nereis procera	*Nereis procera*	72.7	48.5
Spiophanes missionensis	*Spiophanes missionensis*	70.9	87.9
Nepthys spp.	*Nepthys caecoides, N. cornuta franciscana, N. feruuginea*	70.9*	72.7
Thalanessa spinosia	*Sigalion spinosa*	70.9*	60.6
Argissa hamatipes	*Argissa hamatipes*	70.9	28.8
Turbonilla sp.	*Turbonilla sp.*	67.3	47.0
Cadulus sp.	*Gadila sp.*	67.3	0.0
Nothria elegans, iridescens	*Onuphis elegans, iridescens* and *Sp. 1 (SCAMIT)*	66.7*	59.1
Tharyx tesselata	*Monticellina spp., Aphelochaeta spp.*	65.5	59.1
Glottidia albida	*Glottidia albida*	63.6*	74.2
Mediomastus californiensis	*Mediomastus spp.*	61.8	63.6
Olivella baetica	*Olivella baetica*	60.0	34.8
Diastylopsis tenuis	*Diastylopsis tenuis*	60.0*	22.7
Spiophanes bombyx	*Spiophanes bombyx*	58.2	78.8
Amphicteis scaphobranchiata	*Amphicteis scaphobranchiata*	43.6	60.6
Amphideutopus oculatus	*Amphideutopus oculatus*	40.0	68.2
Owenia collaris	*Owenia collaris*	20.0	69.7
Ampharete labrops	*Ampharete labrops*	0.0	69.7

Table 5.6. Comparison of Common Species in the *Amphiodia* Assemblage and SCCWRP Mid-depth Group. (From Bergen et al., 1999) * Denotes dominant in the *Amphiodia* assemblage.

Old Species Name	Current Name	Percent Occurrence: Amphiodia Assemblage	Percent Occurrence: SCCWRP Mid-depth Group
Amphiodia urtica	*Amphiodia urtica*	100.0*	96.3
Pectinaria californiensis	*Pectinaria californiensis*	98.2*	92.6
Pholoe glabra	*Pholoe glabra*	94.4	65.4
Paraphoxus bicuspidatus	*Rhepoxynius bicuspidatus*	92.6	65.4
Heterophoxus oculatus	*Heterophoxus oculatus*	90.7	66.7
Paraphoxus similis	*Foxiphalus similis*	88.9	37.0
Ampelisca brevisimulata	*Ampelisca brevisimulata*	87.0	88.9
Prionospio pinnata	*Paraprionospio pinnata*	87.0	85.2
Axinopsis serricatus	*Axinopsida serricata*	85.2*	55.6
Prionospio malmgreni	*Prionospio Sp. A and B (SCAMIT), Apoprionospio pygmaea*	85.2	90.1
Paraonis gracilis	*Levinsenia spp.*	85.2	48.1
Ampelisca pacifica	*Ampelisca pacifica*	85.2	64.2
Terebellides stroemi	*Terebellides californica, T. reishi, T. sp. Type C*	85.2	76.5
Gnathia crenulatifrons	*Gnathia crenulatifrons*	81.5	71.6
Metaphoxus frequens	*Metaphoxus frequens*	81.5	12.3
Sternaspis fossor	*Sternaspis fossor*	77.8*	58.0
Glycera capitata	*Glycera nana*	77.8*	74.1
Lumbrineris cruzensis	*Lumbrineris spp.*	74.1	79.0
Goniada brunnea	*Goniada brunnea* and *G. maculata*	70.4	60.5
Haploscoloplos elongatus (H. pugettensis)	*Leitoscoloplos pugettensis*	70.4	30.9
Cossura candida	*Cossura spp.*	68.5	56.8
Leptosynapta albicans	*Leptosynapta spp.*	68.5	23.5
Haliophasma geminata	*Haliophasma geminatum*	66.7	34.6
Aruga oculata	*Aruga oculata*	64.8	8.6
Nephtys furruginea	*Nephtys furruginea*	62.9	45.7
Ampelisca pugetica	*Ampelisca pugetica*	62.9	72.8
Oxydromus arenicolus	*Podarkeopsis Sp. A, P. glabra*	61.1	28.4
Spiophanes missionensis	*Spiophanes missionensis*	59.3	100.0
Mediomastus californiensis, Capitita ambiseta	*Mediomastus spp.*	53.7	76.5
Axiothella rubrocincta, Euclymene spp.	*Euclymeninae Sp. A*	66.7	67.9
Sthenelanella uniformis	*Sthenelanella uniformis*	57.4	77.8
Brown ostracod	*Euphilomedes carcarodonta*	24.10 60.5	
Parvilucina tenuisculpta	*Parvilucina tenuisculpta*	16.60 69.1	
Unknown tanaid	*Leptochelia dubia*	72.2064.2	
Amage spp.	*Parmage scutata*	9.1066.7	

5.5.1.2 Slope Fauna

The slope (e.g., > 200-1,000 m) is a transitional zone between the productive shelves and the impoverished deep basins (Figure 5.7) (Thompson et al., 1993; Bakus, 1989). Areal species richness, macrofaunal density, and diversity are generally lower on the slope than on the shelf areas (Figure 5.8). Biomass shows no consistent difference with respect to the shelf but may frequently be higher on the slope because of the dominance of echinoderms.

A number of large echinoderms are characteristic of slope habitats including the sea urchins *Brisaster latifrons*, *Brissopsis pacifica*, and *Allocentrotus fragilis*, and the seastar *Myxoderma platyacanthum* (Thompson et al., 1993). Among the infauna, the polychaetes *Chloeia* and *Cistena* dominate a distinct assemblage on the upper slope. Other characteristic slope infauna include the molluscs *Limifossor*, *Chaetoderma*, and *Tindaria*; polychaetes *Maldane sarsi* and *M. glebifex*, and the amphipod *Ampelisca*. The slope assemblage identified in the MMS studies (SAIC, 1986; Hyland et al., 1991) also was co-dominated by the polychaetes *Chloeia* and *M. sarsi*.

5.5.1.3 Basin Fauna

The basins off southern California are characterized by low macrofaunal density, number of species, and biomass (Figures 5.7 and 5.8). Macrofaunal standing crop is always below 25 grams/square meter compared to the 100-200 grams/square meter typical of shelf habitats (Fauchald and Jones, 1978). The fauna of the nearshore basins (San Pedro, Santa Monica, Santa Barbara) are particularly depauperate because of naturally low dissolved oxygen concentrations in the bottom waters (SLC, 2000; Thompson et al. 1993; Bakus, 1989). The basins serve as a trap for organic matter which, upon bacterial decomposition, depletes the dissolved oxygen of the bottom water. Sills, surrounding the basins and located at the depth of the oxygen minimum layer, restrict circulation to the deep areas of the basins. Thus, the macrofauna of the nearshore basins are restricted to those species that are tolerant of hypoxic conditions (e.g., Figure 5.8b) or can colonize and inhabit the area for short periods following aeration of bottom waters by standing waves or turbidity currents.

There is a high degree of variability in the benthic fauna among the basins off southern California. In Santa Cruz Basin, polychaetes are numerically dominant, while molluscs are dominant in San Nicolas Basin and minor phyla in San Pedro Basin (Fauchald and Jones, 1979a). Faunal assemblages in each basin are unique with few species common to several basins. Only the mollusc *Tomburches* and the polychaetes *Phyllochaetopterus*, *Spiophanes*, and *Sternaspis* were reported by Fauchald and Jones (1978, 1979a) to be common in more than one basin.

5.5.1.4 Hard-Bottom Fauna

Hard bottom areas are scattered throughout much of the Southern California Bight (Figure 5.9). Because of their limited spatial extent and the uniqueness of their biota in comparison to the surrounding soft bottom communities, these areas can be of particular concern. Key studies of these habitats are presented in SLC (2000), SAIC (1995), MEC (1995), Hardin et al. (1994), Lissner and Benech (1993), Lissner et al. (1991), and SAIC (1986).

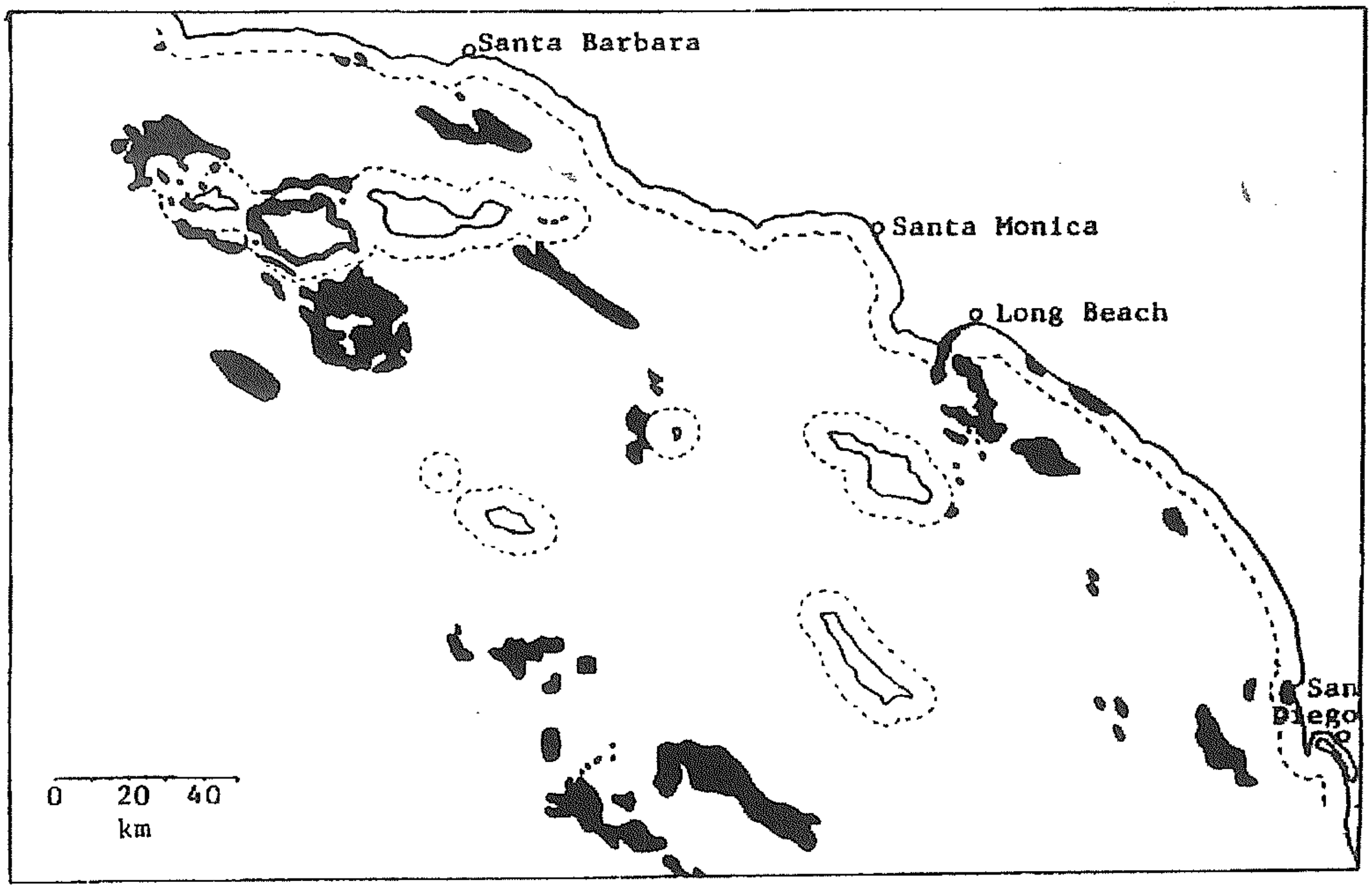


Figure 5.9. Distribution of Hard Bottom Areas (darkened) in the Southern California Bight. Dashed Line Indicates the 3-Mile Limit. Source: MMS (1983).

SAIC (1986) provided a broad-scale characterization of the hard bottom invertebrate assemblages of the western Santa Barbara Channel and Santa Maria Basin north to Pt. San Luis. Approximately 177 taxa were observed from photographic and observer data resulting from submersible and remotely operated vehicle surveys. Dominant phyla included echinoderms (33 taxa) and coelenterates (31 taxa); however, numerous groups such as sponges were probably underestimated due to lack of information on taxonomy and limitations in identifying some taxa from photographs (Table 5.4). These taxa were grouped into three hard-bottom assemblages (generally defined on the basis of substrate relief) and one soft-bottom assemblage. High-relief hard bottom areas are defined as those habitats with vertical relief of one meter or more, while low-relief is less than one meter (SAIC, 1986; Hardin et al., 1994). Common taxa occurring in the highest densities included cup corals and the ophiuroid *Ophiacantha diplasia*. Other common taxa that were locally abundant included crinoids (*Florometra serratissima*), anemones (*Metridium senile* and *Actinostola* sp.), brachiopods (*Terebratulina* sp.), echinoids (*Allocentrotus fragilis*), and tunicates (*Halocynthia hilgendorfi igaboja*). Uncommon taxa that occasionally reached high local abundances included the coral *Lophelia californica*, sea anemones (*Corynactis californica*), gorgonians (*Lophogorgia* sp.), and spot prawn (*Pandalus platyceros*). Densities of species observed from the present survey were generally similar to records from previous studies of the region (e.g., Nekton, 1983, 1984).

A hard-bottom low/medium relief (less than one to about 2 meters relief) assemblage was characterized by ophiuroids (*Ophiacantha diplasia*), brachiopods (e.g., *Terebratulina* sp.), and anemones (*Actinostola* sp.) that typically occurred in the lower relief areas. A high/medium relief assemblage (greater than one to over ten meters or more) was characterized by several taxa including anemones (e.g., *Corynactis californica*) and corals (*Lophelia californica*) that occurred primarily in higher relief areas, and some generalist taxa.

A hard-bottom, generalist assemblage was characterized by numerous taxa including crinoids (*Florometra serratissima*), anemones (*Metridium senile*) cup corals, and sea stars (*Mediaster aequalis* and *Stylasterias forreri*) occurring throughout the range of bottom depths and substrate type and relief present in the survey area.

The soft-bottom assemblage was characterized by numerous soft-bottom organisms including sea pens (e.g., *Stylatula* sp. and *Acanthoptilum gracile*), *Octopus* sp., and sea urchins (*Allocentrotus fragilis* and *Lytechinus pictus*). The predominant assemblages observed throughout the survey area were the low/medium/generalist and soft-bottom assemblages, corresponding to the primary substrate and relief types characteristic of the general study area (e.g., Table 5.4). Overall, these assemblages were very similar to those observed during previous studies of the general region, and extended throughout the entire geographic range of the survey area (e.g., SAIC and MEC, 1995; MEC 1995).

SAIC (1986) concluded that the biological assemblages observed were common throughout the general survey region (western Santa Barbara Channel to at least Pt. Estero, CA), and were similar to results from previous studies. The majority of the observations were conducted at depths from approximately 60 to 200 m, with limited coverage from about 200 m to 250 m. The results indicated relatively high levels of sediment cover at depths less than about 200 m, suggesting high natural levels of sediment transport that may influence the distribution and abundance of biological assemblages. Similarly, observations by Dames and Moore (1982) suggest that hard-bottom assemblages occurring deeper than approximately 150 to 200 m may be characterized by higher diversity and abundance, likely related to lower suspended sediment loads and transport at these deeper depths (Lissner et al., 1991).

Follow-on studies by MMS examined low- and high-relief hard-bottom communities off Pt. Arguello in water depths from 105 to 212 m in the vicinity and north of Platform Hidalgo (Hardin et al., 1994). Several categories of taxa distribution were identified based on substrate relief and/or depth. The solitary coral *Paracyathus sternsii* and ectoproct *Cellaria* spp. were most abundant at shallow stations and an unidentified anenome (white disc and purple tentacles) and unidentified sabellid polychaetes were most abundant at deeper stations, regardless of relief. The cup coral *Caryophyllia* was most abundant in shallow, low-relief habitats and unidentified terrebellid polychaetes were most abundant at deep, low- relief habitats. The solitary ascidian *Halocynthia hilgendorfi igaboja* and the anenome *Metridium senile* were most abundant in low- and high-relief habitats, respectively, irrespective of depth.

Overall, Hardin et al. (1994) and SAIC (1986) noted that natural flux of suspended sediments and sedimentation are important factors affecting large-scale patterns of faunal assemblages in the Santa Maria Basin, particularly in shallow water depths. These studies suggested that hard-bottom fauna which are abundant in shallow, low-relief habitats are tolerant of suspended sediment loads. Conversely, some species such as erect sponges, which are most abundant in deeper (e.g., 200 m and more) high-relief habitats, are relatively more sensitive to suspended sediments.

5.5.2 Importance of Benthos

Benthic macroinvertebrates, form a major portion of the diet of demersal fishes and epibenthic invertebrate predators such as large crustaceans including crabs (Thompson et al., 1993; Bakus, 1989). Many species that depend on benthic macroinvertebrates as primary prey organisms are also of commercial or recreational importance (Section 6); therefore,significant alterations of the benthic community can have direct and indirect effects on these species.

Benthic organisms also play a significant role in transfer of energy, nutrients, and contaminants throughout the marine ecosystem. The bottom community is exposed to a continuous supply of material from the overlying water column including phytoplankton, zooplankton, feces, detritus, and organic aggregates. Much of this material contains constituents of biological importance (e.g., nutrients) that are recycled by the activities of benthic organisms. Energy flow and mineralization of nutrients in marine sediments are quantitatively dominated by benthic microbes, but macrobenthic invertebrates facilitate microbial activity by their burrowing and feeding activities (Thompson et al., 1993; Aller, 1978). Burrowing, burrow ventilation, and pelletization of sediments during feeding have the effect of increasing the availability of oxygen below the sediment surface, thus stimulating microbial activity, and enhancing the flux of biologically-important material from sediment to overlying waters. Feeding activities of subsurface deposit feeders result in a mixing of the upper layers of sediment, thereby providing an opportunity for biological utilization of deeply buried organic matter. Tube building, pelletization, and burrowing can also dramatically alter hydrodynamic processes at the sediment-water interface to enhance resuspension of surface sediments and sediment-associated materials.

5.6 Fish

Fish communities located in the permit area generally fall within two major geographical regions: Southern California Bight, and the southern portion of central California coast (Santa Maria Basin). Both warm and cold water fishes occur seasonally or year-round in a wide range of habitats within these two areas. Key references used to characterize fish communities within the permit area include SLC (2000), Love et al. (2000), Love et al. (1999), and SCCWRP (1999).

5.6.1 Southern California Bight

The Southern California Bight (SCB) includes coastal marine waters to approximately 50 miles offshore from Point Conception to Baja California and has substantial marine fish and fisheries resources. For example, 90% of the fishes known to occur in all California marine waters (554 species in 144 families) (Love, 1996; Eschemeyer and Herald, 1983; and Miller and Lea, 1972) occur in the SCB. Family and species richness and diversity are higher in this area than those in central and northern California. This pattern of diversity seems to be tied to surface temperature and latitude with the highest number of species peaking at 32° N (Cross and Allen, 1993; Horn and Allen, 1978).

The Bight region is characterized as a transitional area, with Point Conception serving as the nominal northern boundary for southern species. The range of southern fish fauna extends from approximately southern California to Baja California with some species found as far south as Central and South America (Horn, 1980). Northern and central species can range as far north as southeastern Alaska. The convergence of prevailing oceanic currents and countercurrents as well as diversity of geomorphological features including deep-sea basins, ridges, banks and offshore islands (e.g., Figure 5.7a) all contribute to a wide array of habitats for marine fishes. Four hundred-eighty five species in 129 families of coastal marine fishes have been reported in southern California waters (Horn, 1974; BLM, 1978; USDI, 1981). A total of 87 species, representing 3 classes and 34 families were collected during the Southern California Bight Pilot Project (SCBPP) trawl surveys in 1994 (Allen et al., 1999). Given the general scaricity of research in some deep basins as well as the difficulties of collecting deep water species, it is likely that the total California and southern California species count exceeds these numbers. Table 5.7 presents results from the 1994 SCBPP trawl survey in southern California. Horn (1980) reported that the importance of non-commercial species lies both in their influence on commercially valuable fish as well as to the overall structure of the marine fish community. Table 5.8 presents a comprehensive summary of the most common southern California fish families, their adaptive zones, and diets.

Due to the nature of the sea floor and the associated fish fauna, the Southern California Bight fish communities are generally divided into two major regions: mainland and island shelf region (including offshore banks and ridges less than 200m in depth), and deep sea basins. A third region, the epipelagic zone, covers both zones 1 and 2 (fishes found in the upper 100-200 m of the water column).

TABLE 5.7. Fish Species Comprising 95% of the Total Fish Abundance in a Regional Trawl Survey of the Mainland Shelf of Southern California at Depths of 10-200 m. July to August 1994.

Scientific Name	Common Name	Abundance	Percent Total	Cumulative
Citharichthys sordidus	Pacific sanddab	4,125	21.8	21.8
Porichthys notatus	plainfin midshipman	1,996	10.6	32.4
Eopsetta exilis	slender sole	1,569	8.3	40.7
Icelinus quadriseriatus	yellowchin sculpin	1,079	5.7	46.4
Citharichthys stigmaeus	speckled sanddab	1,067	5.6	52.0
Microstomus pacificus	Dover sole	961	5.1	57.1
Citharichthys xanthostigma	longfin sanddab	776	4.1	61.2
Sebastes saxicola	stripetail rockfish	658	3.5	64.7
Symphurus atricauda	California tonguefish	584	3.1	67.8
Sebastes diploproa	splitnose rockfish	522	2.8	70.5
Genyonemus lineatus	white croaker	510	2.7	73.2
Lepidogobius lepidus	bay goby	509	2.7	75.9
Zaniolepis latipinnes	longspine combfish	481	2.5	78.4
Zalembius rosaceus	pink seaperch	466	2.5	80.9
Merluccius productus	Pacific hake	398	2.1	83.0
Zaniolepis frenata	shortspine combfish	316	1.7	84.7
Engraulis mordax	norhtern anchovy	308	1.6	86.3
Lycodopsis pacifica	blackbelly eelpout	304	1.6	87.9
Pleuronichthys verticalis	hornyhead turbot	221	1.2	89.1
Hippoglossina stomata	bigmouth sole	203	1.1	90.2
Xeneretmus latifrons	blacktip poacher	191	1.0	91.2
Pleuronectes vetulus	English sole	186	1.0	92.2
Sebastes semicinctus	halfbanded rockfish	172	0.9	93.1
Synodus lucioceps	California lizardfish	171	0.9	94.0
Errex zachirus	rex sole	143	0.8	94.7
Argentina sialis	Pacific argentine	136	0.7	95.4

Source: Allen et al. (1999).

Table 5.8. Fish Families Occurring in Southern California, with Adaptive Zone(s) and Depth Range, Number of Species Recorded in Southern Californian Waters, and the Food Items by Major Category.

			Zooplankton					Nekton				Benthos					
Family	Adaptive Zone and Depth Range (ft)	Number of Species	Ostracoda	Copepods	Larval	Larval	Other	Pelagic fish	Crustaceans	Cephalopods	Other	Algae	Demersal	Mollusks	Crustaceans	Polychaetes	Echinoderm
Myxinidae	Benthic 30 to 2400	3						X					X				
Petrymyzonticae	Pelagic	1						X					X				
Nexanchidae	Bays, shallow to 960	2															
Chlamydoselachidae	Shallow to 1650	1															
Neterodontidae	Demersal, shallow to 492	1											X		X		
Squalidea	Neritic, Shallow to 1200	4											X				
Squantinidae	Neritic, shallow	1											X				
Alepiidae	Epipelagic	2						X									
Sphryaidae	Pelagic	2						X									
Cetorhimidae	Epipelagic	1							X								
Rhincodontidae	Epipelagic	1							X								
Scyliorhinidae	Neritic, shallow to 1380	4											X				
Lamnidae	Epipelagic	3											X				
Odontaspidae	Epipelagic	1						X									
Carcharhinidae	Neritic, shallow to 210	12						X					X		X		
Torpedinidae	Demersal, shallow to 640	1						X					X				
Platyrhinidae	Shallow to 150	1															
Rhinobatidae	Demersal, 0 to 150	2												X	X	X	
Rajidae	Demersal, 60 to 4500	8											X		X		
Mobulidae	Epipelagic	2															
Myliobatidae	Demersal, 0 to 150	1												X	X		
Dasyatidae	Demersal, 0 to 70	3											X	X	X	X	
Gyanuridae	Bays, Beaches	1															
Chimaeridae	Demersal, shallow to 1200	1											X	X	X		
Acipenseridae	Shallow to 400	2															
Albulidae	Shallow	1															
Muraenidae	Rocky Demersal	1											X		X		
Congridae	Sandy Demersal, 30 to 1200	1															
Memichthyidae	Lower mesopelagic, 300 to 6000	2							X								
Ophichthidae	Intertidal and shallow to 60	3															
Mettastomatidae	Benthopelagic	1							X								
Serrivomeridae	Bathypelagic 0 to 1000+	1						X	X	X							
Clupeidae	Neritic	7	X	X	X	X	X						X				
Engraulidae	Neritic, bays, shallow	3	X	X	X	X	X		X								
			(phytoplankton)														
Salmonidae	Pelagic	5															
Alepisauridae	Meso- to bathypelagic, 0 to 6000	1					X	X	X		X						
Alepocephalidae	Meso- to bathypelagic, 150 to 18,000	3							X								
Searsiidae	Mesopelagic, 200 to 3000	3							X								
Osmeridae	Neritic	2															

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			Zooplankton					Nekton				Benthos					
Family	Adaptive Zone and Depth Range (ft)	Number of Species	Ostracoda	Copepods	Larval	Larval	Other	Pelagic fish	Crustaceans	Cephalopods	Other	Algae	Demersal	Mollusks	Crustaceans	Polychaetes	Echinoderm
Argentinidae	Upper mesopelagic, 36 to 900	3							X								
Bathylagidae	Mesopelagic, 0 to 3280	5							X								
Opisthoproctidae	Mesopelagic, 324 to 2940	2		2													
Gonostomatidae	Meso- to bathypelagic, 180 to 3412	6	X	X			X										
Sternoptychidae	Mesopelagic, 330 to 2400	7		X	X			X	X								
Melanostomiatidae	Bathypelagic, 102 to2000	3							X								
Malacosteidae	Bathypelagic, 500 to 1000+	1							X								
Chauliodontidae	Bathypelagic, 240 to 5000	1						X	X	X							
Stomiatidae	Lower mesopelagic, 500 to 1000	1						X	X								
Idiacanthidae	Lower mesopelagic	1						X	X								
Anotopteridae	Epi- to mesopelagic	1			X			X									
Paralepididae	Bathypelagic, 200 to 1500	1			X			X	X	X							
Scopelarchidae	Bathypelagic, >1000	1						X	X								
Scopelosauridae	Mesopelagic	1						X	X								
Synodontidae	Rocky, Sandy, dmeresal, 5 to 150	1						X		X			X				
Myctophidae	U- meso- bathypelagic, 0 to 9500	16		X				X	X		X						
Neoscopelidae	Lower mesopelagic, >1500	1							X								
Batrachoididae	Rocky, sandy, demersal, shallow to 1000	2							X						X		
Ophidiidae	Benthic, 4 to 800	2											X	X	X		
Brotulidae	Benthopelagic, 10 to 840	2											X		X		
Ariidae	Neritic	1															
Gobiesocidae	Rocky, sandy, demersal, intertidal to 35	7												X	X		
Macrouridae	Benthopelagic, 200 to 2000	2											X				
Moridae	Benthopelagic, 1000 to 10,000	2											X		X		
Marlucciidae	Sandy, demersal, shallow to 3000	1						X		X			X		X		
Gadidae	Pelagic, 0 to 1200	1											X	X	X		
Zoarcidae	Benthic, 30 to 7200	10												X			
Enocoetidae	Epipelagic	4											X		X		
Nemirhamphidae	Epipelagic	4															
Delonidae	Epipelagic, 0 to 300							X	X								
Scomberesocidae	Epipelagic	1		X	X												
Cyprinodontidae	Bays, shallow	1															
Atherinidae	Neritic, shallow	3	X	X	X	X	X					X					
Antennariidae	Benthic, near surface to 360	1															
Ogcocephalidae	Benthic, 60 to 372	1															
Ceratiidae	Bathypelagic, 1440 to 5000	1															
Oneirodidae	Meso- to bathypelagic, >1000	2							X								
Oreosomatidae	Pelagic, to 1800	1															
Zeidae	Pelagic, 100 to 1000+	1						X									
Lampridae	Pelagic, 0 to 1680	1						X	X	X							

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			Zooplankton					Nekton				Benthos					
Family	Adaptive Zone and Depth Range (ft)	Number of Species	Ostracoda	Copepods	Larval	Larval	Other	Pelagic fish	Crustaceans	Cephalopods	Other	Algae	Demersal	Mollusks	Crustaceans	Polychaetes	Echinoderm
Melamphaidae	Meso- to bathypelagic, 390 to 6000	2							X								
Anoplogasteridae	Bathypelagic, >2000	1						X	X	X							
Lophotidae	Pelagic, 0 to 300	1						X		X							
Regalecidae	Pelagic, 0 to 1350	1							X								
Trachipteridae	Pelagic, 0 to 300	4						X	X	X							
Gasterosteidae	Sandy, inshore, 0 to 100	2		X	X												
Centriscidae	Pelagic, 0 to 700	1							X								
Syngnathidae	Rocky, inshore, sandy bays, shallow	5													X		
Scorpsenidae	Demersal, shallow to 5000	55				X		X			X		X	X	X	X	
Triglidae	Demersal, 48 to 360	2															
Anoplopomatidae	Demersal, 0 to 1440	1		X	X	X	X						X		X	X	
Branchiostegidae	Rocky, sandy, inshore, 0 to 300	1						X		X			X	X	X		
Echeneidae	Epipelagic	7						X	X								
Carangidae	Pelagic, 0 to 150	13					X	X	X	X							
Nematistiidae	Shallow, inshore	1															
Coryphaenidae	Epipelagic	1						X	X	X							
Branidae	Pelagic	3						X	X	X							
Berreidae	Shallow, inshore	2															
Pristipomstidae	Neritic, surface to 130	2										X		X	X	X	X
Sparidae	Neritic, shallow to 225	1															
Nullidae	Shallow, inshore	1															
Ianiolepididae	Demersal, shallow to 1200	2															
Hexagrammidae	Demersal, intertidal to 1400	3										X	X	X	X	X	
Cottidae	Demersal, intertidal to 1224	34											X	X	X	X	
Agonidae	Demersal, 30 to 1224	8													X	X	
Liparididae	Demersal, intertidal to 5256	3													X		
Serranidae	Inshore, 0 to 600	10						X					X	X	X	X	X
Priacanthidae	84 to 198	1															
Apogonidae	30 to 60	1															
Ephippidae	Shallow, inshore	1															
Sciaenidae	Sandy, inshore, 0 to 400	8						X				X	X		X		
Girellidae	Sandy, inshore, intertidal to 95	1										X		X	X	X	X
Kyphosidae	Shallow, inshore, to 25	1															
Scorpididae	Neritic, inshore, 0 to 130	1			X							X			X	X	X
Chaetodontidae	Shallow to 492	2															
Pentacerotidae	Shallow to 1320	1															
Embiotocidae	Sandy, rocky, inshore	18												X	X	X	
Pomacentridae	Rocky, sandy, inshore, 0 to 150	2			X							X		X	X		X
Mugilidae	Inshore, demersal	1										X		X	X	X	X
Sphyraenidae	Epipelagic, 0 to 60	1						X									

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Family	Adaptive Zone and Depth Range (ft)	Number of Species	Zooplankton					Nekton				Benthos					
			Ostracoda	Copepods	Larval	Larval	Other	Pelagic fish	Crustaceans	Cephalopods	Other	Algae	Demersal	Mollusks	Crustaceans	Polychaetes	Echinoderm
Polynemidae	Shallow	2															
Labridae	Rocky, inshore, 0 to 180	3										X		X	X		X
Bathymasteridae	Rocky, sandy, inshore, 60 to 450	3		X	X	X										X	
Uranoscopidae	Sandy, demersal, 42 to 1260	1						X		X			X				
Anarchichadidae	Demersal, inshore to 400	1															
Blenniidae	Rocky, demersal	3			X										X	X	
Clinidae	Rocky, sandy, demersal	12			X							X		X	X	X	
Cebidichthyidae	Rocky, demersal, intertidal to 80	1															
Stichaeidae	Rocky, sandy, demersal, intertidal to 900	8										X			X	X	
Pholidae	Rocky, sandy, demersal, intertidal to 120	3		X											X		
Amnodytidae	Neritic, shallow to 60	1															
Eleotridae	Inshore	1															
Icosteidae	Pelagic, 60 to 1200	1															
Gobiidae	Sandy, rocky, demersal, intertidal to 318	13												X	X	X	
Trichiuridae	Pelagic, 18 to 1260	3						X	X								
Gompylidae	Pelagic, shallow to 3300	2															
Scombridae	Pelagic	14						X	X	X							
Xiphiidae	Pelagic, 0 to 2000	1						X		X							
Istiophoridae	Pelagic	5						X	X	X							
Luvaridae	Pelagic	1									X						
Centrolophidae	Pelagic	1							X		X						
Tetragonuridae	Pelagic	1									X						
Stromsteidae	Pelagic, 30 to 300	1							X		X						
Cynoglossidae	Sandy, demersal, 5 to 276	1													X		
Bothidae	Demersal, 0 to 1800	6							X				X	X	X	X	
Pleuronectidae	Demersal, 0 to 3000	18											X	X	X	X	X
Ballistidae	Shallow, inshore	3															
Tetradontidae	Shallow, inshore	2															
Diodontidae	Shallow, inshore	2															
Ostracidae	Inshore, shallow to 90	1															
Molidae	Epipelagic	2							X	X		X					
TOTAL FAMILIES = 150																	
TOTAL SPECIES= 528																	

Data from various sources: Love (1996), Eschmeyer and Herald (1983), Miller and Lea (1972), Ebeling, et al. (1970b), Paxton (1967 a and b), Lavenberg and Ebeling (1967), Fitch and Lavenberg (1968 and 1971), Frey (1971), Pinkas, et al. (1971), Quast (1968), Turner, et al. (1969).

The shelf region is made up of many habitats, including diverse offshore and nearshore areas of kelp beds, bays, estuaries, harbors, and artificial reefs (SCCWRP, 1999). Generally, each area can be characterized by the relative occurrence of certain fish species. In 1994, SCCWRP studied southern California coastal waters in depths from 10-200 m as a part of the SCBPP, recording 87 species fishes from 114 stations from Point Conception to San Diego (SCCWRP, 1999). Results indicated that fishes collected in these areas represented one-fourth to one-third of the total fish species collected in the Southern California Bight and almost half of the coastal species. Other SCCWRP studies demonstrated that approximately 20% of the species collected occurred in significant associations. Previous studies by Allen and Moore (1997) and Allen (1982) have identified recurrent species groups in different depth zones on the mainland shelf. The SCCWRP studies also indicated that some distributions are affected by seasonal changes. For example, in Santa Monica Bay, some demersal fish populations moved inshore or to the surface to avoid intruding offshore waters that occurred during upwelling, while pelagic fishes moved offshore during this same period.

Since monitoring began in 1985, the Orange County Sanitation District (OCSD) has conducted trawl surveys on the continental shelf off of Orange County (OCSD, 2000). A total of 145,810 fish representing 114 species have been collected over the past 15 monitoring years. The most commonly collected fish species included Pacific sanddab (*Citharichthys sordidus*), bigmouth sole (*Hippoglossina stomata*), yellowchin sculpin (*Icelinus quadraseriatus*), plainfin midshipman (*Porichthys notatus*), and California lizardfish (*Synodus lucioceps*). Other common fish species include hornyhead turbot (*Pleuronichthys verticalis*), longfin sanddab (*Citharichthys xanthostigma*), and California tonguefish (*Symphurus atricauda*).

The speckled sanddab (*Citharichthys stigmaeus*) and the Pacific sanddab (*C. sordidus*), two of the most abundant species found in the OCSD (OCSD, 2000) and SCCWRP surveys, represent significant forage items for larger fish species and also occur in the diets of many California seabirds (Horn, 1980). These non-commercial species (although the Pacific sanddab is of some commercial value further north) dominate the community structure of fishes from southern California and serve as a vital link role in the food chain.

Other commercially important species such as Dover sole (*Microstomus pacificus*), sablefish (*Anoplopoma fimbria*), and longspine thornyhead (*Sebastolobus altivelis*) are found at depths greater than 200 m within the permit area. These deep-bottom species are considered important in the vertical transfer of nutrients and energy (Horn, 1980). (See Table 5.8 for more information on diets of some major fish families.)

Members of the Scorpaenidae (rockfish) family comprise abundant larval and juvenile fish resources for numerous fish and seabird species, and serve an important ecological as well as an economic role in California fisheries (Lea, 1992). Love et al., (2000) showed that midwater areas at several oil platforms were dominated by young-of-the-year (YOY) or juvenile (up to two years old) rockfishes. Similarly, of the 35 fish species observed in shell mound habitats at the offshore oil platforms, 18 were rockfish species (Love et al., 1999).

In addition to the high abundance of rockfishes at the offshore oil platforms, over 80 pelagic fish species (30 families) are common in the permit area. Table 5.9 presents common pelagic species and their general habitat. Pelagic schooling fish such as the Northern anchovy (*Engraulis mordax*) occur in abundant concentrations in the Southern California Bight. These dense schools attract migrating predatory species such as tunas and mackerels.

Table 5.9 Common Pelagic Fishes and Their Habitat Association in the Southern California Bight.

Family	Common Name	Habitat Association
Exocoetidae	Flying fish	Epipelagic
Hemirlamphidae	Halfbeak family	Epipelagic
Belonidae	Needlefish family	Epipelagic
Molidae	Mola	Epipelagic & Pelagic
Bramidae	Pomfret family	Epipelagic & Pelagic
Xiphiidae	Swordfish family	Epipelagic & Pelagic
Scombridae	Mackerels & Tunas	Epipelagic & Pelagic
Centrolophidae	Medusafish	Epipelagic & Pelagic
Tetragonuridae	Squaretail	Epipelagic & Pelagic
Engraulidae	Anchovy family	Coastally oriented
Clupeidae	Herring family	Coastally oriented
Carangidae	Jacks & Pompanos	Coastally oriented
Stromateidae	Butterfish family	Coastally oriented
Lamprididae	Opah	High seas
Coryphaenidae	Dolphinfish	High seas
Trichiuridae	Cutlassfishes	High seas
Istiophoridae	Billfishes	High seas

5.6.2 Central California

Central California fishes occupy the region from Point Conception north to Point Reyes. Fish communities located in the permit area occur primarily in the Santa Maria Basin, which extends from Point Sur in the north, to Point Conception. Fish communities in the central California portion of the permit area are similar in species composition to areas farther north such as Monterey Bay and off San Francisco. The most common species and groups in nearshore and offshore areas are rockfishes, including splitnose (*Sebastes diploproa*), blackgill (*S. melanostomus*) shortspine thornyhead (*Sebostolobus alascanus*), and longspine thornyhead (*S. altivelis*). Other dominant fish groups include flatfishes (Dover, English, rex sole, and California halibut), eelpouts (Zoarcidae), combfish (*Zaniolepis spp.*), and lingcod (*Ophiodon elongatus*) (SLC, 2000). Fish families characterized by the greatest number of species are summarized in Table 5.10. Fish communities in hard bottom areas south of Moneterey Bay to Morro Bay (north of Point Conception) include rockfishes, painted greenling, ratfish, and lingcod. These communities are typical of the hard bottom areas surveyed in July 1999 in Carmel Canyon (about 60 to 90 m depths), near Carmel Bay (about 110 to 225 m), and off Morro Bay (about 40 to 60 m) (SLC, 2000).

Table 5.10. Fish Families Characterized by the Greatest Number of Species off Central California. Source: BLM, 1978.

Family	Common Name	Number of Species
Scorpaenidae	Scorpionfishes & rockfishes	57
Cottidae	Sculpins	41
Myctophidae	Lanternfishes	21
Pleuronectidae	Righteye flounders	18
Embiotocidae	Surfperches	18
Liparidae	Snailfish	16
Zoarcidae	Eelpouts	14
Gobiidae	Gobies	13
Stichaeidae	Pricklebacks	12
Clinidae	Clinids	12

Pelagic species are frequently found near the continental shelf in areas of upwelling. Several of these fish, such as albacore, migrate far out at sea. Migrating predatory fish such as tunas, mackerels, and salmon are attracted to the dense schools of herrings and anchovies that feed in nutrient rich waters associated with upwelling.

5.7 Marine Mammals and Turtles

Marine mammals off central and southern California constitute one of the most diverse temperate waters faunas in the world (Bonnell and Dailey, 1993; SLC, 2000). Information on status, populations, seasonality, and food habits/foraging strategies are shown in Tables 5.11 and 5.12. Point Conception marks the distributional boundary for several species. Common dolphins and Pacific white-sided dolphins are more common south of Point Conception. Steller sea lions occur mostly north of Pt. Conception, except for the San Miguel Island breeding site, while the breeding range of California sea lions is almost exclusively south of Point Conception. The range of the Guadalupe fur seal reaches its northerly limit at Point Conception. Areas of special biological significance to marine mammals in the Southern California Bight are listed in Table 5.13. North of Point Conception, special areas have not been well documented. The distribution of many of the marine mammals within the permit area are described below, and as summarized in SLC (2000).

5.7.1 Cetaceans

There are 21 species of cetaceans that utilize the waters of the Southern California Bight and Santa Maria Basin. Of these, six are on the Federal Endangered Species List. Of the baleen whales, the humpback whale (*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), and right whale (*Balaena glacialis*) are endangered. Of the toothed whales, only the sperm whale (*Physeter catodon*) is endangered. Distributional information on some of these listed species (i.e., sei and sperm whales) are poorly known.

Summary information for all cetaceans in the general permit region is presented in Table 5.11. Use by cetaceans of the area north of Point Conception can be divided by water depth. In nearshore areas (less than 180 m), gray whales and harbor porpoise (*Phocoena phocoena*) are most often sighted (Bonnell and Dailey, 1993; SLC, 2000). In water depths of 180-1,800 m (the continental slope), schooling cetaceans such as the Pacific white-sided dolphin, Risso's dolphin, and northern right whale dolphin are most common. Many of the larger whales show broader distributional patterns, but most are present on the continental shelf and the continental slope. South of Point Conception, the distribution of marine mammals becomes more complex, due to the presence of the Channel Islands and associated ridges and basins. Humpback, fin, and blue whales appear to concentrate in the western portion of Santa Barbara Channel and along the Santa Rosa-Santa Cortes Ridge. Cetaceans can generally be grouped into three distributions, inshore, continental shelf, and open ocean, as shown in Table 5.14. Depth distributions are similar to those in northern California. The gray whale is the only large baleen whale found in the inshore group.

Table 5.11 Summary Information on Cetaceans in Southern and Central California waters (SLC, 2000; Hill, 1981).

Species	Protective Status	Population Size/Stock	Seasonal Presence	Food Habits, Foraging Strategy	Comments
Gray whale	Delisted from Federal Endangered Status	16,500 ± 2900 S. Pacific	Winter, spring	Near shore, bottom filter feeder - feeds mostly in northern summering grounds	Entire population migrates through the area twice annually
Humpback whale	Endangered - Federal	850 - 2500 N. Pacific	All seasons - peak in summer and fall	Continental shelf, vertical feeding - mostly planktonic Crustacea	Breeds off west coast of Baja, California
Fin whale	Endangered - Federal	9000 - 17,000 N. Pacific	All seasons	Continental shelf, "swallower" - mainly krill and anchovies	
Blue whale	Endangered - Federal	1500 N. Pacific, gradually increasing	Summer, fall, winter	Continental shelf, "swallower" - almost exclusively feeds on krill, feeds only during summer	
Sei whale	Endangered - Federal	9000		Continental slope - copepods in summer, krill and small fish in winter	
Right whale	Endangered - Federal	150 - 200 N. Pacific	Unknown - sighted in Santa Barbara Channel on 4/17/81		
Minke whale	Protected - Marine Mammal Protection Act	Unknown	All, but mainly spring and summer	Near shore - euphausiids and small fish	
Sperm whale	Endangered - Federal	780,000 N. Pacific	Unknown	Continental shelf and slope - cephalopods and mesopelagic fishes	Migration route generally seaward of the S. California Bight
Common dolphin	Protected - Marine Mammal Protection Act	125,000 S. California Bight (most numerous cetacean in the Bight)	Year-round resident	Near shore - schooling fish and deep scattering layer fishes	Much more common south of Pt. Conception
N.E. Pacific long-finned pilot whale	Protected - Marine Mammal Protection Act	400-2000 S. California	Year-round resident	Near shore - primarily squid	

Table 5.11. Continued.

Risso's dolphin	Protected - Marine Mammal Protection Act		All seasons	Continental shelf - cephalopods	
Pacific white-sided dolphin	Protected - Marine Mammal Protection Act		Spring, summer, fall	Continental shelf & slope - cephalopods and small schooling fish	More common south of Pt. Conception, 2nd most abundant species in S. California Bight
N. right whale dolphin	Protected - Marine Mammal Protection Act		Fall, winter, spring	Continental shelf - pelagic and mesopelagic fishes and squids	
Killer whale	Protected - Marine Mammal Protection Act	Unknown	Unknown	Continental shelf - cephalopods, mesopelagic fishes	
Dall porpoise	Protected - Marine Mammal Protection Act	80,000-1,800,000 S. Pacific	Fall, winter	Continental shelf and Near shore - herring, sauries, hake, mackerel, and squid	
Pacific bottlenose dolphin	Protected - Marine Mammal Protection Act		All seasons - non-migratory	Opportunistic feeder on pelagic fish and benthic invertebrates	
Beaked whales; Hubbs, Cuvier's	Protected - Marine Mammal Protection Act	Unknown	Unknown	Continental shelf - squid, some deepwater fishes	

Note that current status on Federal Endangered Species list can be found in NOAA (1999).

Table 5.12 Summary Information on Southern and Central California Pinnipeds (Hill, 1981).

Species	Protection Status	Population Size	Seasonal Use of California Waters	Food Habits, Foraging Areas	Breeding Areas
California sea lion *Zelpohas californianus*	Protected - Marine Mammal Protection Act	42,000 (SCB)	All seasons - coastal waters to 50 km out	Nearshore and estuarine anadromous & schooling fish - epi-& mesopelagic	San Miguel, San Nicolas, Santa Barbara & San Clemente Islands - almost all breeding south of Pt. Conception
Steller sea lion *Eumetopias iubatus*	Federal-threatened	1,500 (CA)	All seasons - continental shelf & slope 50-200 m	Epi- & mesopelagic feeder schooling & anadromous fish	San Miguel Island (extreme southern limit)
Northern fur seal *Caliorhinus urainus*	North Pacific Fur Seal Convention	1,189,000 (NP)	All season - continental slope and upwelling areas	Epi- & mesopelagic feeder	San Miguel Island
Guadalupe fur seal *Arctocephalus townsendii*	State of California Endangered Federal-threatened	<2,000 (total)	Rarely observed in California waters.	Not well documented	Breeds only on Isla de Guadalupe, Mexico. Ado Nuevo Island (37^{0}N).
N. elephant seal Mirounga angustirostris	Protected - Marine Mammal Protection Act and State of California	28,000 (SCB)	All seasons	Demersal & benthic prey species to 180m depth	San Miguel Island, San Nicholas Island, Ado Nuevo Island
Harbor seal *Phoca vitulina*	Protected - Marine Mammal Protection Act	3,000 (SCB)	All seasons - coastal	Demersal prey to 80m depth	Northern Channel Islands

Note that current status on Federal Endangered Species list can be found in NOAA (1999).

Table 5.13. Areas of Special Biological Significance to Marine Mammals of the Southern California Bight (SLC, 2000; McArdle, 1997).

Zone	Area	Significance
Santa Barbara Channel	San Miguel Island and vicinity	Largest pinniped breeding colonies in the Southern California Bight: five species of breeding pinnipeds (including world's largest California sea lion and northern elephant seal rookeries and the only northern fur seal rookery in the U.S. outside of Alaska); exceptionally heavy use of nearshore waters by foraging cetaceans (pacific white-sided and common dolphins) and pinnipeds; seasonal gathering area of humpback whales (endangered) and migratory path of gray whales.
	Shores of Santa Rosa and Sant Cruz Islands and out 10 km	Pupping grounds of harbor seals; exceptionally heavy use of nearshore waters by foraging pinnipeds.
	Anacapa Island, Anacapa Passage, and water over the Ventura Shelf	Exceptionally heavy use by foraging pinnipeds and cetaceans; migratory pathway of gray whales.
	Waters within a 15 km radius of Pt. Conception	Concentration of migratory gray whales.
Santa Rosa Ridge	San Nicolas Island to a radius of 10 km	Second largest pinniped rookery in the Southern California Bight; year-round presence of pups; exceptionally heavy use of nearshore waters by foraging pinnipeds.
	Santa Rosa Ridge from San Nicolas Island to Santa Rosa Island	Exceptionally heavy use by foraging pinnipeds (sea lions, elephant seals), and cetaceans (common, white-sided, and northern right whale dolphins); major migration pathway of large baleen whales (endangered); area of greatest concentration of cetaceans in the Southern California Bight.
Santa Cruz Basin	Santa Barbara Island to a radius of 20 km	Important pinniped breeding rookeries and seasonal hauling grounds; exceptionally heavy use of surrounding waters by foraging pinnipeds.
	Eastern sill of Santa Cruz Basin	Major concentration of cetaceans, especially minke and pilot whales and several species of porpoises.

Table 13. Continued.		
Santa Monica Basin	Waters within 15 km radius of Point Dume	Migration pathway of gray whales.
	Waters within a 10 km radius of Point Vicente	Concentration of migrating gray whales; year-round residence of bottlenose dolphins and pilot whales.
San Pedro Basin	Santa Catalina Island to 10 km seaward, especially to the south	Major feeding grounds for cetaceans and area of maximum seasonal concentrations of pilot whales in the Southern California Bight; migration pathway of gray whales; pupping site for harbor seals.
	Waters within 10 km of mainland	Migration pathway of gray whales.
	Waters surrounding Point Loma and north San Diego County	Concentration of migratory gray whales.
	Waters within 10 km of mainland shoreline, especially between San Clemente and Dana Point	Migration pathway of gray whales; heavy seasonal concentration of common dolphins.
San Clemente Ridge	San Clemente Island to a radius of 10 km	Sea lion breeding rookery on west side.

[a]Distances are approximate. Descriptions of abundances were derived from mean density (no./km^2) of animals in area recorded on ship and actual transect surveys. Density categories refer to numbers observed on all or most surveys of the area from 1975 - 1978. Exceptionally heavy use (5 mammals/km^2), and heavy use (1-5 mammals/km^2).

Table 5.14. Geographical Distributions of Cetaceans in the Southern California Bight (after BLM, 1978 in Hill, 1981). * Most commonly observed species.	
Inshore Group	Common dolphin (young observed)*
	Pacific bottlenose dolphin (young observed)
	White-sided dolphin (young observed)*
	Dall porpoise
	Minke whale
	Gray whale (young observed)
	Pilot Whale (young observed)*
Continental Shelf	Risso's porpoise (young observed)
	Right whale porpoise (young observed)
	Various beaked whales
	Blue whale
	Sei whale
	Sperm whale
	Humpback whale
Open Ocean	False killer whale
	Pygmy killer whale
	Pygmy sperm whale
	Long-beaked dolphin
	Rough-toothed porpoise

5.7.2 Pinnipeds

Six species of pinnipeds inhabit the Southern California Bight and Santa Maria Basin. These include the California sea lion (*Zalophus californianus*), the Steller (northern) sea lion (*Eumetopias jubatus*), the northern fur seal (*Calorhinus ursinus*), the Guadalupe fur seal (*Arctocephalus townsendii*), the northern elephant seal (*Mirounga angustirostris*), and the harbor seal (*Phoca vitulina*). All but the Guadalupe fur seal occur both north and south of Point Conception. Guadalupe fur seals are found primarily south of the permit area. Information on pinniped distribution and habits is summarized in Table 5.12.

The California sea lion and the northern fur seal are the two most abundant species of pinnipeds in the study area. California sea lions are primarily a coastal species which is often seen hauled out on land. Most breeding of this species occurs south of Point Conception in the Channel Islands and in coastal areas of the Southern California Bight. The northern fur seal is the most pelagic of the otariid seals, and spends most of the year at sea, feeding in areas of up to 150 m depths.

Although the Guadalupe fur seal is on the state endangered species list, much of the remaining population of this animal resides in Mexico, and only a few are seen in the Channel Islands each year.

Pinnipeds are opportunistic feeders, preying commonly on schooling fishes and squid (Antonelis and Fiscus, 1980). Diet varies with season depending on the movements and seasonal abundance of prey. Northern fur seals feed mainly in deep offshore waters while the sea lions primarily utilize coastal areas. These species tend to be epipelagic or mesopelagic feeders. In contrast, harbor seals and northern elephant seals are demersal feeders with harbor seals utilizing coastal areas and elephant seals feeding in waters up to 600 m in depth (Ainley and Allen, 1992).

5.7.3 Sea Otter

The southern sea otter (*Enhydra lutris*) is native to California waters, and is currently listed as threatened on the Federal Endangered Species List. Historically distributed from Baja California through the Gulf of Alaska and Bering Sea, the current range of the California stock is from Pismo Beach north to Soquel Point (Monterey Bay) (SLC, 2000; Jones and Stokes, 1981), although stray otters are occasionally seen in the northern Channel Islands. Current population estimates (Spring, 2000) for sea otters are about 2,300 individuals from Half Moon Bay south to Santa Barbara (http://www.usgs.gov). Otters are found primarily along rocky coast near points of land and large bays where *Nereocystis* and *Macrocystis* beds occur. They may be found seaward to the 30 m contour. Sea otters are an ecologically important species because they manipulate community composition by consuming grazers in the rocky nearshore environment. This changes the growth and survival of kelp and other algal communities. Otters feed on molluscs, echinoderms and crustaceans (Bonnell and Dailey, 1993).

5.7.4 Marine Turtles

Three species of marine turtles may occur in the Southern California Bight. All three are endangered or threatened species and are infrequently seen in the permit region. The species include the leather-backed turtle *(Dermochelys coriacea sechlegeli)*, loggerhead *(Caretta caretta)* and the green sea turtle *(Chelonia mydas)*. All three species inhabit tropical and subtropical waters of the west coast, only occasionally straying north.

5.8 Seabirds

Substantial numbers of seabirds, migratory shorebirds, and waterfowl occur in coastal and offshore waters of the permit region. However, only the area south of Point Conception possesses offshore islands that are important breeding habitats for seabirds (e.g., Baird, 1993; Sowls et al., 1980). Due to importance of these habitats, the following discussion focuses on these areas, although many of these birds forage within the general permit area and migrants can be found along the entire central and southern California coast.

The Southern California Bight region, which includes that portion of the Pacific Ocean bounded by the California current to the west and extending east along the southern California coast from Point Conception to Baja California, Mexico, contains a wide array of avian habitats (Baird, 1993). Open sea, bays, estuaries, offshore islands, rocky cliffs, sandy beaches, mudflats, and salt and freshwater marshes are some of the many and varied habitats that are essential to resident and transient birds. Seabirds, suggested to be the "most numerous and conspicuous avian group" found in offshore lease areas, comprise approximately 15 families and 80 species of avifauna (USDI, 1983). The largest group of birds present offshore are migrating shearwaters and phalaropes which can number into the millions in May and June. Equally high numbers of migrating and visiting seabirds and shorebirds such as shearwaters, phalaropes, petrels, jaegers, and alcids can be found in the Bight region in the winter. O ver 2.5 million seabirds or shorebirds may pass through or reside in this area at a given time. Seventeen species of seabirds (approximately 9.0% of all California breeding seabirds) nest in the Southern California Bight region, producing 30-40,000 young annually (Figure 5.10).

Life histories and habitat requirements of these birds are extremely diverse. Some seabirds reside on the open seas for their entire lives with the exception of breeding periods which draw them to areas like the Channel Islands or appropriate coastal sites. Others feed and roost in numerous habitats including the open sea, nearshore waters, and bays and littoral regions of offshore islands and the mainland. Feeding behaviors are similarly varied and include aerial plunges and surface skimming, as well as deep water dives and underwater flying in pursuit of prey such as fish and marine invertebrates.

Productivity of seabirds is related to the coastal upwelling of nutrient-rich water that commences every spring. Phytoplankton blooms initiate increases in zooplankton that serve to feed other invertebrates and fishes which attract and nourish concentrations of breeding seabirds. Seabirds in California concentrate their breeding activities from as early as late winter through June and early July. This coincides with the time of peak plankton production" (Baird, 1993; Sowls et al., 1980). Years of poor plankton production probably account for variability in annual records of seabird production.

At the northern boundary of the Bight region, seabird populations are often smaller. This area represents a complicated junction of warm and cold water masses such as the cold California current and cold California coastal current, separated by masses of

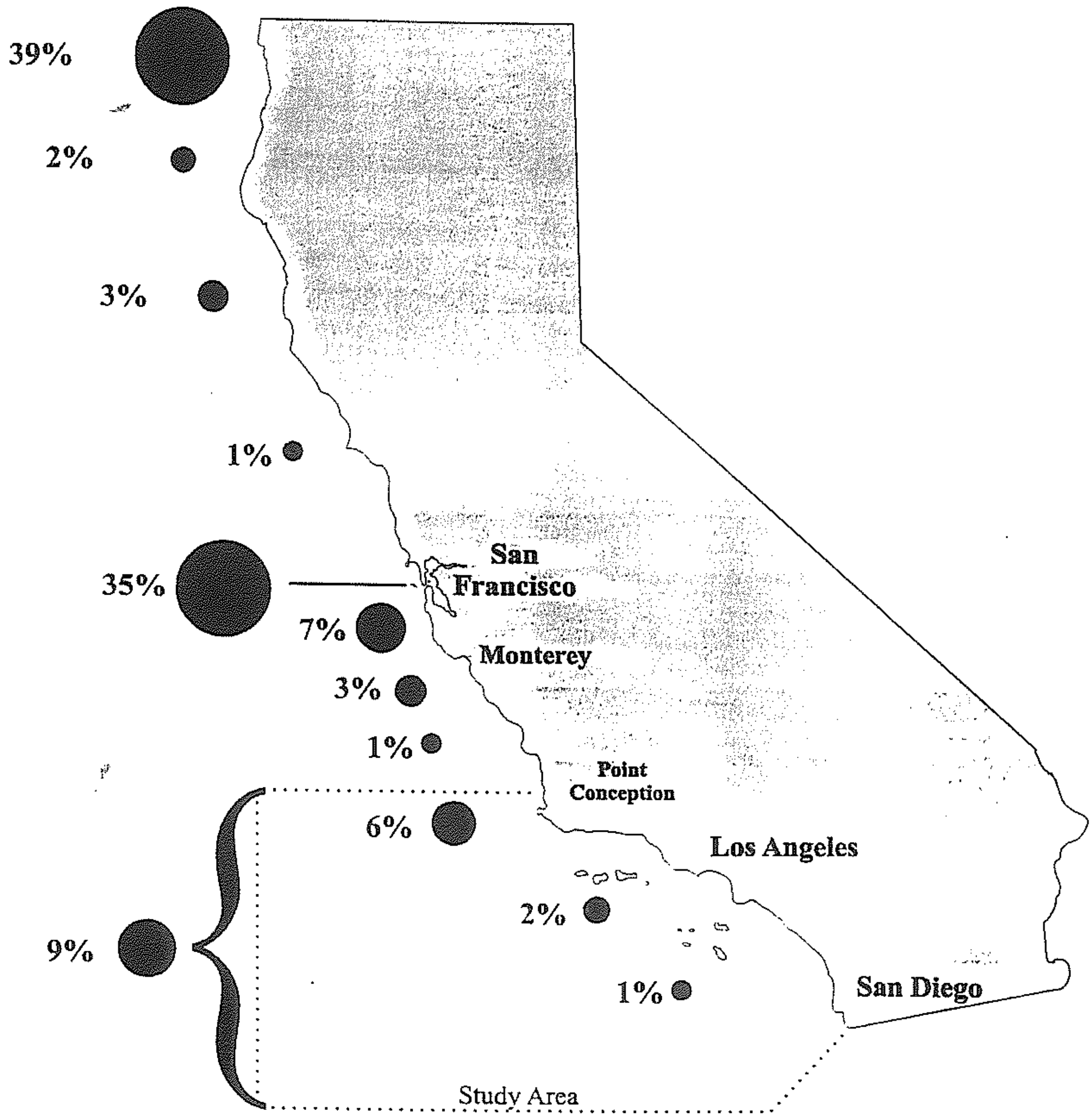

Figure 5.10. Percentages of the California Breeding Population of Seabirds. Source: Sowls et al. (1980).

warm water. Point Conception and the northern Channel Islands are an important boundary zone between warm and cold waters in California (Sowls et al., 1980). The northern Channel Islands represent the limit of breeding ranges for some seabird species and can be considered critical habitats susceptible to environmental perturbations. For example, the entire California populations of Black Storm Petrels, Brown Pelicans, and Xantus' Murrelets nest on the Channel Islands. In addition to these species, other nesting seabirds, especially cormorants and gulls, congregate on these northern island coasts because they provide optimum protection from mainland predators, favorable wind and sun exposure, and access to important foraging and roosting sites.

5.8.1 Breeding Records

Summaries of records of seabird colonies or nesting sites are presented below, as documented in Lehman (1994), Small (1994), Sowls et al. (1980), SAI (1983), and USDI (1983).

Northern Channel Islands

San Miguel Island (largest seabird breeding colonies in Southern California Bight)

- Brandt's Cormorant
- Pelagic Cormorant
- Black Oystercatcher
- Western Gull
- Cassin's Auklet
- Ashy Storm Petrel
- Pigeon Guillemot
- Xantus' Murrelet

Anacapa Island (second largest seabird breeding colonies in Southern California Bight)

- Brown Pelican (Anacapa Island represents the most important breeding site)
- Brandt's Cormorant
- Double-Crested Cormorant
- Pelagic Cormorant
- Black Oystercatcher
- Western Gull
- Pigeon Guillemot

Santa Rosa Shores and Santa Cruz Island (Major breeding and roosting colonies of seabirds; nearsho areas important for foraging.)

Brandt's Cormorant

Pelagic Cormorant

Black Oystercatcher

Western Gull

Cassin's Auklet

Ashy Storm Petrel

Pigeon Guillemot

Xantus' Murrelet

Southern Channel Islands

Santa Barbara Island and Sutil Island

Black Storm Petrel (only U.S. nesting site)

Ashy Storm Petrel

Brown Pelican

Brandt's Cormorant

Double-Breasted Cormorant

Pelagic Cormorant

Black Oystercatcher

Western Gull

Pigeon Guillemot

Xantus' Murrelet (perhaps the largest colony in world)

Cassin's Auklet

Santa Catalina Island

Brandt's Cormorant

Western Gull

Xantus' Murrelet

San Nicholas Island

Brandt's Cormorant

Black Oystercatcher

Western Gull

San Clemente Island

Brandt's Cormorant

Black Oyster Catcher

Western Gull

Xantus' Murrelet

Point Conception Region

Offshore areas are important for migrating and foraging birds, and heavy use by shearwaters and waterfowl has been reported.

Pelagic Cormorant

Pigeon Guillemot

5.8.2 Species Accounts

The Southern California Bight region provides important migrating corridors and winter habitat for many seabirds. Table 5.15 summarizes the species of seabirds observed in southern California offshore areas along with information on the season of occurrence, abundance, habitat, and behavior. The table also lists vagrant or casual seabird species in the region and whether they are associated with the open sea, nearshore waters, or littoral habitats.

Table 5.15. Seabird Use of Southern California Bight Region (Sowls et al., 1980; Terres, 1980; CCMS, 1981; Bender et al., 1974). Activity Codes:

Abundance	Occurrence	Behavior
A - Abundant (in large numbers); C - Common (reliably seen, not necessarily in large number)	M - Migrant; P - Permanent Resident	1 - Breeding; 2 - Roosting
U - Uncommon (small numbers or not always seen); R - Rare (not out of range or season, but unexpected)	T - Temporary Resident; V - Visitor	3 - Feeding
I - Irregular (unexpected and not regularly seen or recorded)		
* - Numbers reported to be declining; ** - Endangered species status		

Species	Offshore Waters				Nearshore Waters				Island Littoral				Mainland Littoral				Diet & Feeding Mechanisms
	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	
Common Loon (*Gavia immer*)		U, M-T, 3															Dives for small fish
Arctic Loon (*Gavia arctica*)	A, M, 3					C-A, T, 2-3											Dives for small fish
Red-throated Loon (*Gavia stellata*)						C-A, T, 2-3											Dives for small fish
Black-footed Albatross (*Diomedea nigripes*)				U, V, 2-3													Surface feeds for fish, squid, garbage
Northern Fulmar (*Fulmarus glacialis*)		I-C, T, 2-3															Surface feeds and dives for fish (esp. jellyfish)
Pink-footed Shearwater (*Puffinus creatopus*)	U-C, M, 2-3		U-C, M, 2-3	U-C, M, 2-3													Surface feeds and dives for fish and squid
Slender-billed Shearwater (*Puffinus tenuirostris*)	U, V, 2-3																Surface feeds or dives for fish
*Flesh-footed Shearwater (*Puffinus carneipes*)	R, V, 2-3			R, V, 2-3													Surface feeds and dives for fish and squid
Sooty Shearwater (*Puffinus griseus*)	C-A, M, 2-3		C-A, M, 2-3	C, T, 2-3	C, M, 2-3		C, M, 2-3										Surface feeds and dives for fish, squid, garbage
*Manx Shearwater (*Puffinus puffinus*)	C, M, 2-3																Swims and dives for fish, squid, and crustaceans

Species	Offshore Waters				Nearshore Waters				Island Littoral				Mainland Littoral				Diet & Feeding Mechanisms
	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	
Fork-tailed Storm Petrel (*Oceanodroma furcata*)	R, V, 2-3	R, V, 2-3															Surface feeds for animal matter, fats, small fish, and crustaceans
*Leach's Storm Petrel (*Oceanodroma leucorpha*)			C, M, 2-3								R, T, 1-2-3						Surface feeds for marine animals and fats
Ashy Storm Petrel (*Oceanodroma homochroa*)			U, M, 2-3								P, 1-2-3						Surface feeds for larvae of spiny lobster, fish, shellfish, and algae
Black Storm Petrel (*Oceanodroma melania*)	R, M, 2-3			R, M, 2-3							U, T, 1-2-3						Surface feeds for larvae of spiny and rock lobster, and animal fats
Red-billed Tropicbird (*Phaethon aethereus*)	R, V, 2-3																Dives for fish and squid
**Brown Pelican (*Pelecanus occidentalis*)					U-C, M, 2-3	U-C, T, 2-3	U-C, M, 1-2-3	U-C, T, 1-2-3									Aerial dives for fish
*Double-crested Cormorant (*Phalacrocorax auritus*)					C, P, 2-3	C, P, 2-3	C, P, 1-2-3	C, P, 1-2-3									Dives or swims for fish
*Brandt's Cormorant (*Phalacrocorax penicillatus*)					C-A, M-P, 2-3	C, P, 2-3	C, P, 1-2-3	C, P, 1-2-3									Dives or swims for fish
Pelagic Cormorant (*Phalacrocorax pelagicus*)	U, P-M, 2-3	U, P, 2-3	U, P-M, 2-3				U, P, 1-2-3										Dives or swims for fish
Surf Scoter (*Melanitta perspicillata*)					C-A, M, 2-3	A, T, 2-3	C-A, M, 2-3										Dives for shellfish and fish
White Winged Scoter (*Melanitta deglandi*)					U, M, 2-3	U, T, 2-3	U, M, 2-3										Dives for shellfish
Black Scoter (*Melanitta nigra*)						R, V, 2-3											Dives for shellfish
Red-breasted Merganser (*Mergus serrator*)					U, M, 2-3	C, T, 2-3	U, M, 2-3	R, V, 2-3									Dives for fish and marine crustaceans

5.9 Unique Environments

The State of California has proposed a draft classification of managed areas that are of ecological or biological significance (CORMP, 1999). These areas include: Areas of Special Biological Significance, Ecological Reserves, Natural Preserves, and Refuges, among other categories. The list below summarizes unique areas in the Central and Southern California Planning Areas that overlap with the permit area general region. However, these areas are generally located beyond the range of reasonable transport distances for discharges from the production platforms, and they should not be adversely affected by the discharges. Most of the special aquatic sites are located close to the shoreline, and the boundaries of these areas are at least 3 miles from any of the platforms. The closest special aquatic site to any platform would be the Santa Barbara Channel Ecological Preserve, the boundary of which is located about 900 meters from Platform Henry. However, as summarized in Section 3, water quality objectives will be fulfilled within 100 meters of the discharge point. Since the boundary of this special aquatic site is well beyond 100 meters, it should not be adversely affected. Dispersal of drilling muds can extend over large areas (e.g., a few kilometers), but at concentrations that would not result in significant effects to the marine environment. Although the locations of future exploratory operations are not known at this time (except that they would be within the 83 lease blocks covered by the general permit), exploratory operations must undergo a site-specific environmental review prior to approval. The general permit provides that individual permits may be issued with special effluent limitations, including no discharge if necessary, to ensure that special aquatic sites are not adversely affected. It should also be noted that certain leases in the Tanner-Cortes Banks area had been covered in the previous permit, but would not be covered in the reissued permit since the leases in the area are no longer active.

Areas of Special Biological Significance

San Miguel, Santa Rosa, and Santa Cruz Islands ASBS

Santa Barbara Island and Anacapa Island ASBS

San Nicolas Island and Begg Rock ASBS

Mugu Lagoon to Latigo Point ASBS

Santa Catalina Is.-Subarea One, Isthmus Cove to Catalina Head ASBS

Santa Catalina Is.-Subarea Two, North End of Little Harbor to Ben Weston Point ASBS

Santa Catalina Is.-Subarea Three, Farnsworth Bank Ecological Reserve, ASBS

Santa Catalina Is.-Subarea Four, Binnacle Rock to Jewfish Point ASBS

San Clemente Island ASBS

Newport Beach Marine Life Refuge ASBS

Irvine Coast Marine Life Refuge ASBS

Heisler Park Ecological Reserve ASBS

Clam Refuges (Clam Preserves)

Morro Beach Pismo Clam Preserve

Ecological Reserves

Bolsa Chica Ecological Reserve

Buena Vista Lagoon Ecological Reserve

Farnsworth Bank Ecological Reserve

Goleta Slough Ecological Reserve

Abalone Cove Ecological Reserve

San Miguel Island Ecological Reserve

Heisler Park Ecological Reserve

Upper Newport Bay Ecological Reserve

Anacapa Island Ecological Reserve

Morro Rock Ecological Reserve

Santa Barbara Island Ecological Reserve

Offshore Rocks and Pinnacles Ecological Reserve

Marine Resource Protection Act Ecological Reserves

Vandenberg Ecological Reserve

Big Sycamore Canyon Ecological Reserve

Natural Preserves - subunits of the State Park System within larger classified units

Heron Rookery Natural Preserve (in Morro Bay State Park)

Morro Dunes Natural Preserve (in Montana de Oro State Park)

Morro Estuary Natural Preserve (in Morro Bay State Park)

Morro Rock Natural Preserve (in Morro Bay State Park)

Pajaro River Mouth Natural Preserve (in Zmudowski State Beach)

Pismo Dunes Natural Preserve (in Pismo State Beach)

Point Dume Natural Preserve (in Point Dume State Beach)

San Mateo Creek Wetlands Natural Preserve (in San Onofre State Beach)

San Simeon Natural Preserve (in San Simeon State Park)

Santa Clara Estuary Natural Preserve (in McGrath State Beach)

Santa Rosa Creek Natural Preserve (in San Simeon State Park)

Refuges

California Sea Otter Game Refuge

Laguna Beach Marine Life Refuge

Niguel Marine Life Refuge

Point Fermin Marine Life Refuge

Irvine Coast Marine Life Refuge

Newport Beach Marine Life Refuge

Catalina Marine Science Center Marine Life Refuge

Reserves

Lover's Cove Reserve

Pismo Invertebrate Reserve

Point Cabrillo Reserve

State Coastal Sanctuary

California's entire coastline

State Estuaries

Morro Bay State Estuary

Natural Reserves

Carpinteria Salt Marsh Reserve

Coal Oil Point Natural Reserve

Santa Cruz Island Reserve

Younger Lagoon Reserve

Other

Channel Islands Marine Sanctuary

Santa Barbara Channel Ecological Preserve

5.10 Impacts to Pacific OCS Organisms

Discharges from oil and gas exploration, development, and production as addressed by the general permit are expected to have only localized effects on water quality and marine organisms in southern and central California OCS waters. Results of numerous field studies in various oceanic environments including offshore Pacific (Pt. Arguello to Point Conception region), Gulf of Mexico, mid-Atlantic, and the Beaufort Sea, indicate that potential impacts will generally be short-term with rapid dispersion of the discharges in receiving waters (Section 3). Based on reviews of existing information (e.g., Neff, 1997) regarding potential impacts to organisms from produced water discharges, effects are expected be less than significant on the California OCS due to strong mixing and/or the deep water environment of the region that promotes rapid and effective dilution and dispersion (Section 4). The most likely potential impacts may include the following:

- Exposure of plankton (both phytoplankton and zooplankton), pelagic organisms (fishes, mammals, and some birds), and fouling organisms on the platforms to produced water plumes;
- Localized smothering or fouling of benthic organisms by drilling muds and cuttings; and

- Physical alteration of the substrate/habitat as a result of accumulation of muds and cuttings on the bottom.

The bottom effects could result in the localized mortality and displacement of some benthic species and possibly some demersal fishes. Furthermore, altered substrate (e.g., shell mounds) may encourage another community to become established. Regionally, this type of alteration is not expected to be significant, given the limited number of platforms and since the spatial extent of the changes will be limited to areas near the base of individual platforms.

It is highly unlikely that motile organisms such as fish, marine mammals, or birds would suffer direct mortality as a result of exposure to either drilling fluids and cuttings or produced waters. Chronic toxicity from direct exposure is also not expected to affect these organisms due to their ability to avoid the source of such discharges. Further, reduction of prey species availability, such as plankton and forage fish, is not likely to occur to an extent which would affect these top level consumers.

Potential chronic or sublethal impacts that may affect planktonic and benthic communities include decreased growth and development, impaired reproduction, changes in metabolic activities, and changes in respiratory and feeding activity (Section 4). Effects to these communities may also include alteration in relative abundance, species richness, diversity and community composition. Reduction in recruitment to benthic communities could result from either reproductive impairment or habitat alteration. Bioaccumulation of pollutants from the discharges is not expected to pose significant risks to marine organisms (Section 4). This is because most discharge constituents are not significantly elevated in the receiving waters or bottom sediments (Section 3), and/or they have low potentials for uptake and retention (i.e., low bioconcentration factors; Section 4).

MMS (1997) summarized oil and gas activities in the Pacific OCS for three recent years (1992-1994) and assessed the potential for cumulative effects on the ecosystem . During this period, 50 development wells were drilled and two production platforms were brought on line. The report addressed key issues related to this permit: drilling mud discharges and commercial fisheries.

With regard to drilling discharges, the MMS report cites the following results of studies conducted by SAIC and MEC as part of the California OCS Monitoring Program (CAMP) (SAIC and MEC, 1995):

- Barium concentrations near Platform Hidalgo (Santa Maria Basin) increased by up to 300 times compared to background concentrations, but over time concentrations returned to near background levels. When associated with drilling mud, barium (barium sulfate) is nontoxic, with relatively small potentials for bioaccumulation.
- Changes in hard-bottom fauna, (e.g., decreased abundance of sabellid polychaetes, the tunicate *Halocynthia hilgendorfi*, cup coral *Caryophyllia spp.*, and galatheid crabs), as discussed in Section 4.0, was likely due to effects of burial and high suspended sediment loads rather than responses to chemical toxicity.

- There appeared to be no residual effects on hard-bottom communities and some species experienced enhanced recruitment near platforms.

Therefore, overall effects on soft- and hard-bottom communities appear to be physical in nature, transient to short-lived, and localized to areas in the vicinity of the drilling activity.

Effects of OCS activities on commercial fisheries were the subject of MMS studies reported by Immamura et al. (1993), also focusing on Platform Hidalgo. The major results of these studies, which specifically examined rockfish species, are as follow:

- Mid-water species were the most dominant form at the platform and bottom-associated species were absent but common on nearby natural reefs.
- The platforms are thought to provide habitat for pelagic rockfish larvae since the resident rockfish were exclusively juveniles.
- Rockfish on natural reefs exhibited no differences in abundance or community variables that were related to proximity to Platform Hidalgo.

Previous studies have demonstrated minimal potentials for accumulation of contaminants in fishes that are exposed to produced water (Continental Shelf Associates, 1997) or discharges of drill muds and cuttings (Neff, 1987). As further evidence that drilling discharges are not increasing the potential for biological effects due to chemical components, the MMS report described the condition of mariculture operations on platforms in the Santa Barbara Channel. As an operational matter, mussels that quickly foul and attain large size on platform jackets are harvested and marketed commercially for consumption by humans. Harvest volumes have averaged 20 tons/month for 10 months of the year. Oysters, scallops, and clams also are cultivated on the platforms. Chemical analysis of bivalve tissues from the platforms have demonstrated the general absence of contaminant bioaccumulation. Consequently, exposures to platform wastes are not expected to be harmful to the health of resident organisms or their consumers, including humans.

6. COMMERCIAL AND RECREATIONAL FISHERIES

California coastal and offshore regions represent major fishery areas for both commercial and sport/recreational interests. For the entire Pacific coast, commercial fisheries comprise a valuable resource that totaled over one billion dollars in 1998 (NMFS, 1999). For California, over 33 million pounds of fishes, with an estimated value of approximately $110 million, were commercially landed in 1998.

Commercial and recreational fishing along the California coast utilizes several gear types that target a wide variety of fish and invertebrate species. The most common gear types include trawls, trolling, longlines, and gillnets (FMA, 1999). The major component of the West Coast fisheries is groundfish (e.g., rockfishes and flatfishes, sablefish), which comprise over 45 percent of the catch. Squid (14 percent), miscellaneous species (10 percent), tuna (6 percent), crab (6 percent), shrimp (5 percent), and salmon (almost 5 percent) also contribute significantly to the fisheries.

The following information describes commercial and recreational fishing from San Luis Obispo to Los Angeles, a region inclusive of the permit area. Information on commercial fisheries along the California coast is taken from the California Department of Fish and Game (CDFG) commercial fisheries catch block data (1994-1998) (CDFG, 1999a). Recreational catch statistics are summarized from the Pacific States Marine Fisheries Commission (PSMFC) RecFin database located on the Internet for northern and southern California (PSMRF, 1997) and from the CDFG Commercial Passenger Fishing Vessel (CPFV) database, 1993-1997. A detailed assessment of Essential Fish Habitat (EFH) is presented in a separate report (EPA, 2000). The EFH addresses potential impacts to managed fish and invertebrate species contained in the Pacific Fishery Management Council (PFMC) fishery management plans (FMP). These plans include Pacific Coast Groundfish, Pacific Salmon, and Coastal Pelagic species within the permit area.

6.1 Commercial Fisheries

Commercial fishing in the offshore region occurs at water depths ranging between shore and 1,000 m (approximately 3,000 feet) (Joint Oil/Fisheries Committee, 1986). Figure 6.1 presents total commercial fisheries catch by California Department of Fish and Game catch block (1994-1998) in central and southern California.

The trawl fishery found in central and southern California is a mobile fishery, where a trawl net is dragged behind a boat at slow speeds either in midwater (without contacting the bottom) or along the bottom (Joint Oil/Fisheries Committee, 1986). The most common species targeted by trawlers are ridgeback shrimp, spot prawn, rockfishes, flatfishes and sea cucumbers. In the Santa Maria Basin (and over most of the permit area), trawlers fish at water depths up to 400 fathoms (approximately 2,400 feet) (Joint Oil/Fisheries Committee, 1986). Most trawl fishing targets species from soft bottom and low relief (less than 1 m tall) hard bottom, where gear can effectively catch target species. Areas with high relief (greater than 1 m tall) are generally not commercially targeted by trawlers due to the potential for gear loss. Hook and line fisheries (set or long lines) in central and southern California target several species of rockfishes

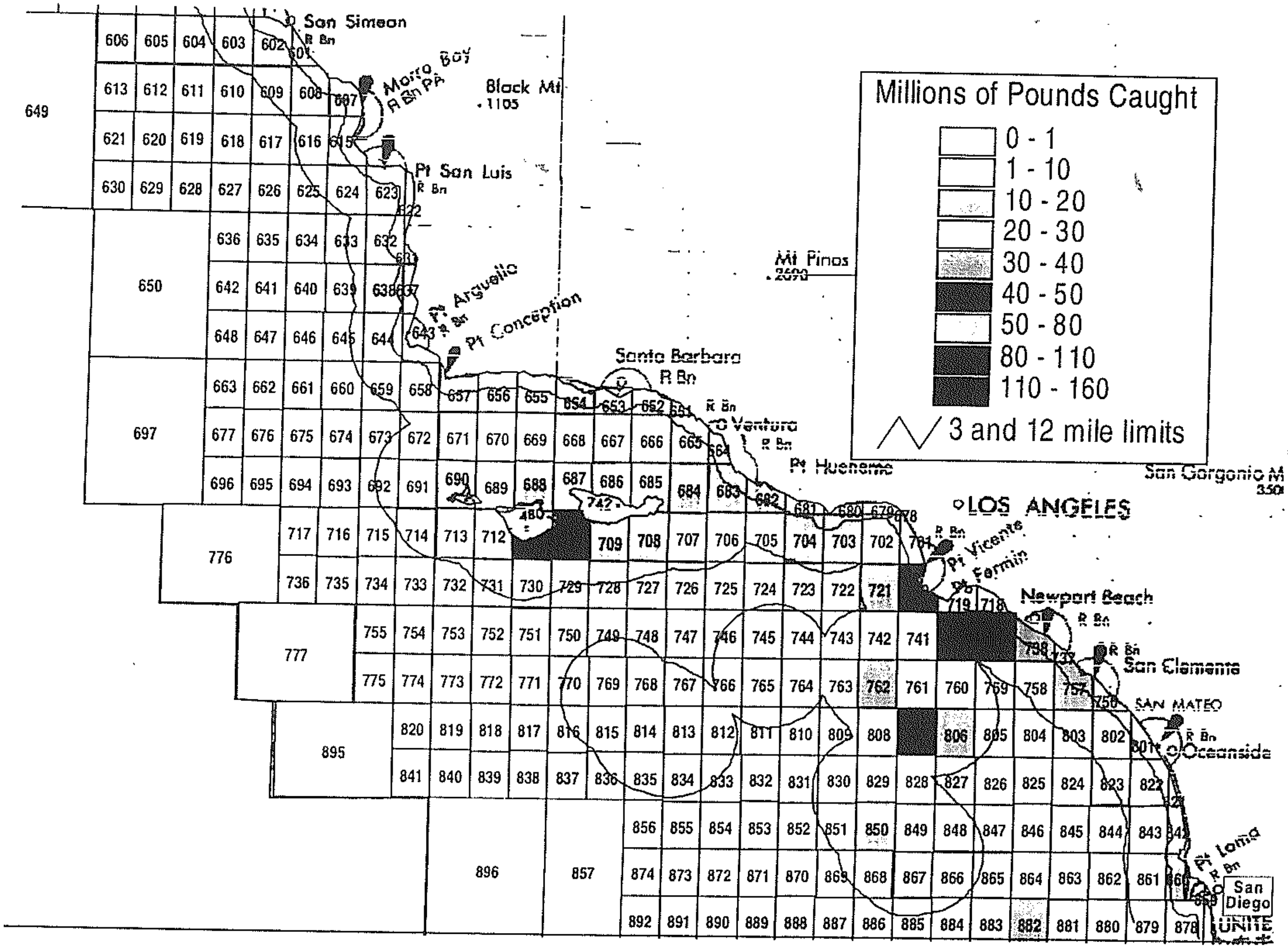

Figure 6-1. California Department of Fish and Game (CDFG) commercial fisheries catch block data for central and southern California, 1994-1998.

(vermilion, boccacio, and chilipepper), lingcod, and cabezon with few seasonal restrictions (Joint Oil/Fisheries Committee, 1986).

The exception to this is the recent bag limit changes imposed by California Department of Fish and Game for boccacio rockfish. Abundances of this species have declined significantly causing them to be the first rockfish along the California coast to be a candidate species on the Threatened and Endangered species list (NMFS, 1999). Hook and line fisheries typically target deep-water rocky outcrops where they deploy a long line of baited hooks over the hard bottom feature.

Two types of gill net fisheries are common throughout the permit area. Set gill nets utilize anchors to hold the net in position near rocky reefs and are left unattended for up to 24 hours. Set gill net fisheries target a wide range of species including halibut, seabass, rockfishes, and some sharks (Joint Oil/Fisheries Committee, 1986). Drift gill nets target mostly pelagic species, such as swordfish and sharks, and a drift gill net fishery for these species exists at most of the major ports in central and southern California (Hanan et al., 1993). Both types of gill nets are used year round and typically fish in water depths from shore to 75 m (250 feet). However, a deep-water rockfish fishery over rocky outcrops exists in water depths up to nearly 303 m (1,000 feet) (Joint Oil/Fisheries Committee, 1986).

Trap (pot) fisheries in southern and central California target generally three species of crabs (red rock, yellow, and brown) and lobster. Traps are placed in nearshore areas from shore to approximately 90 m (300 feet) water depth. The crab and lobster fisheries are similar in gear type and use, but differ in fishing season. Lobster season opens the first Wednesday in October and closes on the first Wednesday after March 15th, while the crab (Dungeness) season is closed between July and November (Joint Oil/Fisheries Committee, 1986).

Trolling is a common fishery throughout the permit area that targets primarily salmon and albacore. A baited hook and line is attached to the end of a troll line that extends 30 to 90 m (100-300 feet) behind the fishing vessel (Joint Oil/Fisheries Committee, 1986). Several trolling lines can be used at a time.

Another productive fishery in central and southern California is the purse seine fishery. This fishery targets mainly pelagic schooling fishes such as anchovy, sardines, and mackerel (Joint Oil/Fisheries Committee, 1986). This fishery has strict bag limits/quotas and only remains open until the quotas are filled (Joint Oil/Fisheries Committee, 1986).

There are a variety of seasons and closures for some of the most commonly targeted species. For example, California halibut can only be taken commercially between March 14th and June 16th in trawl grounds between 1 and 3 nautical miles from the mainland shore to Pt. Arguello to the north and Pt. Mugu to the south (CDFG, 1999b). CDFG catch block number 720, located off Palos Verdes, had some of the highest catches within the permit area totaling nearly 85 million pounds (Table 6.1). However, most of the catch was from purse seine operations which target pelagic species, including northern anchovy (*Engraulis mordax*), Pacific mackerel (*Scomber japonicus*), and sardines (*Sardinops sagax*).

Table 6.1. Top Four Commercial Catch Blocks between Morro Bay and Los Angeles, 1994-1998.

Catch Block/Number	Location	Total Pounds (millions)
638	off Purisima Point, between Morro Bay and Santa Barbara	50.48
720	off Palos Verdes Point, south of Manhattan Beach	84.11
739	just south of Long Beach	47.75
740	just south of Long Beach	43.49

Data Source: CDFG (1999a)

In addition, Table 6.2 lists the top 20 commercially collected fishes and invertebrates collected in the catch blocks listed in Table 6.1.

Table 6.2. Top 20 Commercially Collected Fish and Invertebrate Species Between Morro Bay and Los Angeles, 1994-1998.

Catch Block No.	Species	Gear Types	Total Pounds
638	Market squid	purse seine	14967027
	Market squid	purse seine	13937098
	Market squid	purse seine	9220909
	Pacific sardine	purse seine	4413250
	Market squid	purse seine	4033695
	Pacific sardine	purse seine	957289
	Northern anchovy	purse seine	688730
	Pacific sardine	purse seine	580511
	Pacific mackerel	purse seine	499602
	Pacific mackerel	purse seine	374485
	Pacific mackerel	purse seine	343878
	Pacific mackerel	purse seine	124911
	Market squid	purse seine	107946
	Pacific sardine	purse seine	40801
	Northern anchovy	purse seine	26200
	Jack mackerel	purse seine	21910
	Rockfish, boccacio	hook and line, trawl	18272.5
	Pacific bonito	purse seine	14429
	Chinook salmon	troll	13472
	Spot prawn	trawl, trap	10823.35

Table 6.2. Continued.

Catch Block No.	Species	Gear Types	Total Pounds
720	Pacific sardine	purse seine	22308807
	Pacific sardine	purse seine	13752654
	Pacific sardine	purse seine	10015013
	Market squid	purse seine	8303838
	Pacific sardine	purse seine	6704930
	Pacific mackerel	purse seine	5192294
	Market squid	purse seine	4547784
	Pacific mackerel	purse seine	2130144
	Pacific sardine	purse seine	1744588
	Pacific mackerel	purse seine	1546877
	Pacific mackerel	purse seine	1234717
	Pacific mackerel	purse seine	1192097
	Market squid	purse seine	958916
	Northern anchovy	purse seine	883697
	Jack mackerel	purse seine	486746
	Northern anchovy	purse seine	437676
	Red urchin	diver	327783
	Northern anchovy	purse seine	295063
	Northern anchovy	purse seine	224529
	Red urchin	diver	208322
739	Pacific sardine	purse seine	11851050
	Pacific sardine	purse seine	8910929
	Pacific sardine	purse seine	6468510
	Pacific sardine	purse seine	5047753
	Pacific mackerel	purse seine	3587088.5
	Pacific mackerel	purse seine	2959942.5
	Pacific mackerel	purse seine	2803453
	Pacific sardine	purse seine	1276958
	Pacific mackerel	purse seine	1262256.1
	Pacific mackerel	purse seine	895167.9
	Market squid	purse seine	493094.5
	Jack mackerel	purse seine	431714
	Jack mackerel	purse seine	211715
	Northern anchovy	purse seine	187039
	Northern anchovy	purse seine	144772
	Jack mackerel	purse seine	142248
	Jack mackerel	purse seine	105982
	Jack mackerel	purse seine	103201
	Yellowtail	purse seine, long lines	68593
	California barracuda	drift gill net, troll	48262

Table 6.2. Continued.			
Catch Block No.	Species	Gear Types	Total Pounds
740	Pacific sardine	purse seine	14555059
	Pacific sardine	purse seine	4742076
	Pacific sardine	purse seine	3531491
	Pacific sardine	purse seine	3130495
	Pacific mackerel	purse seine	3077544.41
	Pacific mackerel	purse seine	2867705.05
	Pacific mackerel	purse seine	1957705.5
	Pacific sardine	purse seine	1949908
	Pacific mackerel	purse seine	1748998.55
	Pacific mackerel	purse seine	1470222.05
	Northern anchovy	purse seine	677354
	Jack mackerel	purse seine	525359
	Jack mackerel	purse seine	261354
	Market squid	purse seine	230016
	Jack mackerel	purse seine	174964
	White croaker	hook and line, gill net (set), trawl	152849.77
	White croaker	hook and line, gill net (set), trawl	143454.17
	Jack mackerel	purse seine	138712
	California barracuda	drift gill net, troll	109312.4
	Market squid	purse seine	105891

San Luis Obispo (Morro Bay) to Santa Barbara

Total pounds of commercially important species between Morro Bay and Santa Barbara are relatively evenly distributed (Figure 6.1). Catches in Block 638 were the highest in this area, at over 50 million pounds between 1994-1998 (Table 6.1). Species in this block were collected primarily with purse seines and included market squid, Pacific sardines, northern anchovy, chub (Pacific) mackerel, and Pacific bonito (Tables 6.2 and 6.3). Other species collected by trawlers in the region include rockfishes, flatfishes (Dover sole, petrale sole, rex sole, and Pacific sanddabs), and sablefish. Invertebrates comprised a large portion of the commercial catch, typified by market squid, spot prawn, ridgeback prawn, Pacific ocean shrimp, California spiny lobster (Panulirus interruptus), unspecified rock crab (Cancer spp.), sea cucumbers, and red urchin.

Santa Barbara to Los Angeles

Commercial fishing in the Santa Barbara region is important because: (1) of the wide variety of gear types that target a range of fisheries, with over 20 species harvested commercially; and (2) the majority of fish caught in the Santa Barbara Channel and Santa Maria Basin fishing grounds are sold as fresh catch in local markets and restaurants, rather than reduced or frozen for sale to large distribution networks (Joint Oil/Fisheries Committee, 1986). Common fisheries in the Santa Barbara region include trawl catches of ridgeback shrimp, spot prawn, pink shrimp, rockfish, a variety of sole, and sea cucumbers. At specified times of the year (mid-March to June), trawlers are allowed to drag in shallow state waters for halibut and some incidental catches of shark (Joint Oil/Fisheries Committee, 1986).

Table 6.3. Common Commerical Fisheries Species Collected Between Morro Bay and Los Angeles.		
Common Name	**Morro Bay to Santa Barbara**	**Santa Barbara to Los Angeles**
Albacore tuna	X	
Bank rockfish	X	
Blackgill rockfish	X	X
Black skipjack tune		X
Bluefin Tuna		X
Boccacio rockfish	X	
Bullet mackerel	X	
Cabezon	X	
California barracuda		X
California halibut	X	X
California scorpionfish		
California sheephead	X	X
California spiny lobster	X	X
Chilipepper rockfish	X	
Chinook salmon	X	X
Copper rockfish		X
Dover Sole	X	
Grass rockfish	X	
Jack mackerel	X	X
Leopard shark		X
Lingcod	X	
Longspine thornyhead	X	X
Market squid	X	X
Northern anchovy	X	X
Night smelt		X
Pacific bonito	X	X
Pacific mackerel	X	X
Pacific sanddab	X	
Pacific sardine	X	X
Petrale sole	X	
Red urchin	X	X

Table 6.3. Continued.		
Common Name	**Morro Bay to Santa Barbara**	**Santa Barbara to Los Angeles**
Rex sole	X	
Ridgeback prawn	X	X
Rock crab (unspecified)	X	X
Rockfish (group gopher	X	X
Rockfish (group red)	X	
Rockfish (group rosefish)	X	
Rockfish (group small)	X	
Rockfish (unspecified)	X	X
Sablefish	X	X
Sea Cucumber	X	X
Shortspine thornyhead	X	
Shrimp (pacific ocean)	X	
Skate (unspecified)	X	
Skipjack tuna		X
Spot prawn	X	X
Surfperch (unspecified)		X
Swordfish	X	X
Thornyheads (unspecified)	X	X
Thresher shark	X	X
Top snail		X
White croaker		X
Widow rockfish	X	
Yellowtail rockfish	X	X

Note: Data represents top 20 species for total pounds landed, 1994-1998.

Source: CDFG Commercial Catch Block data.

In this region. catch Blocks 683, 684, and 704 had total catches ranging between 14 million (catch Block 684) and nearly 20 million pounds (catch block 704) (Figure 6.1). The majority of the catch within these blocks was pelagic species collected with purse seines. These species included market squid, Pacific sardine, northern anchovy, and chub mackerel. Invertebrates collected in these blocks included spot prawns, red urchins, sea cucumbers, and California spiny lobster.

Selected Commercially Important Invertebrates

Habitats and ranges of commercial invertebrates vary over the permit area. Their ranges and habitat preferences are summarized in Table 6.4 and are briefly described below.

Nearshore Benthic Areas

Rock crabs, the Dungeness crab, and spiny lobster are generally found in the shallow areas of the permit area. These species occur in less than 100 m of water as adults. Larval and juvenile stages occur in bays and estuaries. While rock crabs and spiny lobsters prefer rock or sand-rock substrates, Dungeness crabs show a preference for sandy bottoms.

Offshore Benthic Areas

Shrimp and prawns occur in 40-500 m of water. Pandalid shrimp concentrate in waters 100-200 m deep, while ridgeback prawn can be found at 40-100 m. Ocean shrimp and spot prawn are found on green mud or mixed green mud-sand bottoms which are found only in limited areas along the coast. Spot prawns also occur in rocky bottoms in deep waters offshore (Jones and Stokes, 1981).

Pelagic Invertebrates

Squid are epipelagic species, widely distributed in the offshore waters of central and southern California. They spawn in inshore waters in January and February in southern California (Leet et al., 1992). Aggregations occur prior to inshore spawning migration. The Channel Islands are the most important spawning areas, although spawning can occur all along the coast in appropriate habitats (usually, soft bottom).

Table 6.4. Natural history information for invertebrates of commercial importance.

Species	Depth/Substrata Distribution	Geographical Distribution	Food Habits	Location of Principal Fishery
Ocean shrimp	40-500 m; concentrations between 100-200 m; green mud, mixed green mud and sand	Alaska to San Diego but rare south of Pt. Conception		Santa Barbara area
Spot Prawn	45-475 m; concentration 150-20 m	Alaska to San Diego	Detritus	Santa Barbara area
Ridgeback prawn	*40-100 m*	Santa Barbara Channel		Santa Barbara area
Dungeness crab	Overall: 2-90 m; concentrations at 2-35 m in sandy bottoms	Alaska to around Pt. Conception	Carnivorous predator	Santa Barbara area
Rock crab	Nearshore; depths <55 m rocky areas	British Columbia to Baja California	Little known - has been known to eat various molluscs	Los Angeles area
Spiny lobster	Low intertidal to 70 m; rocky and rock-sand	Monterey Bay to Baja California	Molluscs, variety of benthic fauna and flora	Los Angeles and San Diego area
Squid	Epipelagic	Entire study area	Primarily crustaceans; copepods; euphausiids, also fish and other cephalopods	Los Angeles area
Red abalone	Intertidal to 540 ft; most in 10-50 ft; hard bottoms	Abundant in central California; considered occasional south of Pt. Conception	Herbivore grazer	Central California, Santa Barbara area
Pink abalone	20-80 ft; hard bottoms	More abundant south of Pt. Conception, Santa Barbara Is. and San Clemente Island	Herbivore grazer	Evenly fished in all three areas of concern
Green abalone	Low tide to 25 ft.; hard bottoms	South of Pt. Conception	Herbivore grazer	Los Angeles area
Black abalone	Mostly intertidal; hard bottoms	Central and southern California	Herbivore grazer	Santa Barbara area
White abalone	15-200 ft. - some deeper; hard bottoms	South of Pt. Conception	Herbivore grazer	Los Angeles area

6.2 Recreational Fisheries

The southern California marine area is defined as San Luis Obispo County south to the Mexican Border (NOAA, 1999). Recreational fisheries in this area concentrate on a wide variety of habitats, including nearshore reefs, kelp beds, the Channel Islands, and offshore oil platforms. Charter boats concentrate on these areas and commonly collect rockfishes, kelp bass, halibut, sheephead, and lingcod. Over 10 million fish were caught by recreational anglers in the region between 1994 and 1998. The five most abundant fish species (in terms of numbers of individuals) collected were chub (Pacific) mackerel (1,875,400), white croaker (1,120,500), barred sandbass (*Paralabrax nebulifer*; 1,037,300), yellowtail (*Seriola lalandi*; 972,900), and kelp bass (*P. clathratus*; 880,100). Other commonly landed fishes in southern California included Pacific barracuda (*Sphyraena argentea*) and various members of the Scorpaenidae family such as vermilion rockfish (*Sebastes miniatus*), California scorpionfish (*Scorpaena guttata*), and greenspotted rockfish (*Sebastes chlorostictus*). Common recreational fishes collected in Los Angeles County (including Manhattan Beach) include chub mackerel, sand bass, croaker, and grunion on a seasonal basis (PSMRF, 1997).

7. COASTAL ZONE CONSISTENCY DETERMINATION

7.1 Requirements of Coastal Zone Management Act

The Coastal Zone Management Act requires that states make consistency determinations for any federally licensed or permitted activity affecting the coastal zone of a state with an approved Coastal Zone Management Program (CZMP) (16 USC Sec. 1456[c][A] Subpart D). Under the Act, applicants for federal licenses and permits must submit a certification that the proposed activity complies with the state's approved CZMP and will be conducted in a manner consistent with the CZMP. The state then has the responsibility to either concur with or object to the consistency determination. For general NPDES permits for outer continental shelf (OCS) exploration, development, and production, EPA is considered an applicant submitting the general permit to the state for a consistency determination. Consistency certifications are required to include the following information (15 CFR 930.58):

1. A detailed description of the proposed activity and its associated facilities.

2. A brief assessment relating the probable coastal zone effects of the proposal and its associated facilities to relevant elements of the CZMP.

3. A brief set of findings indicating that the proposed activity, its associated facilities, and their effects are consistent with relevant provisions of the CZMP.

4. Any other information required by the state.

7.2 Relevance of Requirements

Consistency determinations are required if a federally licensed or permitted activity "affects" the coastal zone. Discharges of drill muds and cuttings and produced waters during exploration, development and production will occur in federal waters outside California's coastal zone (three-mile limit). Because these discharges could affect California's territorial seas or coastal waters, a consistency assessment for the general permit has been prepared.

7.3 Consistency Assessment

The California Coastal Management Program (CMP) was approved in 1978 and established the California Coastal Commission as the lead agency for program implementation. Policies of the California CMP that are potentially relevant to waste discharges from offshore oil and gas exploration are set forth in various sections of the California Coastal Act. Section 30230 of the Coastal Act specifies the following standard for protection of the marine environment:

> "Marine resources shall be maintained, enhanced, and, where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Use of the marine environment shall be carried out in a manner that will

sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms ... "

The California Coastal Act also sets forth standards for protection of habitats of populations of marine animals. Section 30231 states that:

> "The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained, and where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment..."

If a proposed activity cannot meet the provisions of Sections 30230 and 30231 of the Coastal Act, it can be analyzed under Section 30260:

> "Coastal-dependent industrial facilities shall be encouraged to locate or expand within existing sites and shall be permitted reasonable long-term growth where consistent with this division. However, where new or expanded coastal-dependent industrial facilities cannot feasiblely be accommodated consistent with other policies of this division, they may nonetheless be permitted in accordance with this section and Sections 30261 and 30262 if (1) alternative locations are infeasible or more environmentally damaging; (2) to do otherwise would adversely affect the public welfare; and (3) adverse environmental effects are mitigated to the maximum extent feasible."

Waste discharges associated with oil and gas exploration, development, and production in the portion of California covered under this general NPDES permit comply with and will be conducted in a manner consistent with the relevant California Coastal Management Program policies. This assessment is based on the following findings:

1. Coastal habitats will be managed to maintain the biological, physical, and chemical characteristics of the habitats which contribute to their capacity to support living resources. This finding is based on analyses in Sections 4.0 and 5.0 of the ODCE indicating that coastal habitats are unlikely to experience significant degradation from oil and gas-related discharges defined by this permit.
2. Offshore areas will be managed to maintain sport/commercial, commercial, and subsistence fisheries. This finding is based on analyses in Sections 4.0 and 6.0 and a separate EFH analysis indicating that fisheries harvests are unlikely to experience significant degradation from oil and gas-related discharges defined by this permit.
3. Estuaries, wetlands, and tideflats, will not be significantly affected by chemical constituents in oil and gas-related discharges defined by this permit. This finding is based on analyses in Section 3.0 indicating that constituents in these discharges will be rapidly diluted and are likely to be undetectable in the vicinity of these coastal habitats, particularly due to the large distances (>3 miles) between potential discharge sources and these resources.

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